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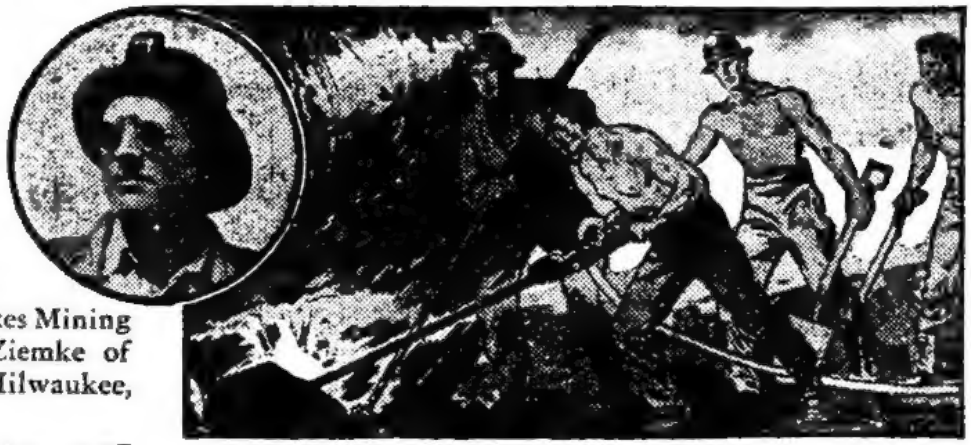
Suffocation Clawed Their Throats

Quick Wits Save Cave-In Victims In Old Gold Mine



"Two miners were entombed by a cave-in at the end of a drift 800 feet under ground," writes Mining Engineer P. Donald Ziemke of 2032 W. Keefe Ave., Milwaukee, Wis.

"A huge boulder lay in the path of the rescuers. We had to blast. We worked furiously... minutes might mean life or death. And then, with the blast ready...

"We found the push-down generator (which furnishes spark for the charge) wrecked. In the excitement some one had pushed a mine car over it.

"But the shift boss kept his head. He ran to the dynamite magazine, where we always kept a flashlight, and brought it out on the double. He unscrewed the lens and bulb, flipped on the switch. Then he plunged the ignition wires in... and—

"The blast let go... the boulder was shattered... we got the men out, and not a second too soon. They were up to their armpits in water, with the air so bad their miner's light had gone out. No doubt about it, *fresh* DATED 'Eveready' batteries saved these two lives."

Signed P. Donald Ziemke

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IN TIMES TO COME

Making up a magazine is much like working out a jig-saw puzzle: the pieces frequently don't fit just where you hoped they would. That's why "Flareback", by Kent Casey, and "Flight of the Dawn Star", by Robert Moore Williams were crowded over to the March issue. I think that I'll have to divide this Division of Prophecy into two sections: the certainties and probabilities. For next month, "Flareback" and "Flight of the Dawn Star" are moved to certainties.

And with them will be "The Master Shall Not Die", a novelette of immortality that, I think, merits the phrase "the best immortality story we have yet published". It's by R. DeWitt Miller, who wrote that excellent—and from the looks of the letters so far received, much enjoyed—article on radium.

And Dow Elstar, co-author of "Stardust Gods" and author of the very short story "Thunder Voice" in this issue, will have the cover story, "Something from Jupiter", a sympathetic novelette of another world's life. It has something of Weinbaum's touch, I think, and something that is uniquely Elstar's. Manly Wade Wellman's short story, "Wings of the Storm", should be in the March ASTOUNDING, too. I'm interested in two things about that story; first, I think the story itself is an unusually pleasant little fantasy, and second, because Dold has done a quite-unusual illustration for it. I hope you'll comment in Brass Tacks on both of those.

In the Probable Division—here are items that will appear in the March or April issues. "The Great Eye" is a fact article—about the 200" telescope, by R. DeWitt Miller. Nat Schachner has an excellent novelette based on the positron article R. D. Swisher had in ASTOUNDING some months ago: "Negative Space". Eando Binder will appear with "Eye of the Past". And one of those new names I've been looking for—John Victor Peterson—has graduated from the standing of fan and letter-author, to author, with "Martyrs Don't Mind Dying".

The Editor.

HE THOUGHT HE WAS LICKED—THEN A TIP GOT BILL A GOOD JOB!

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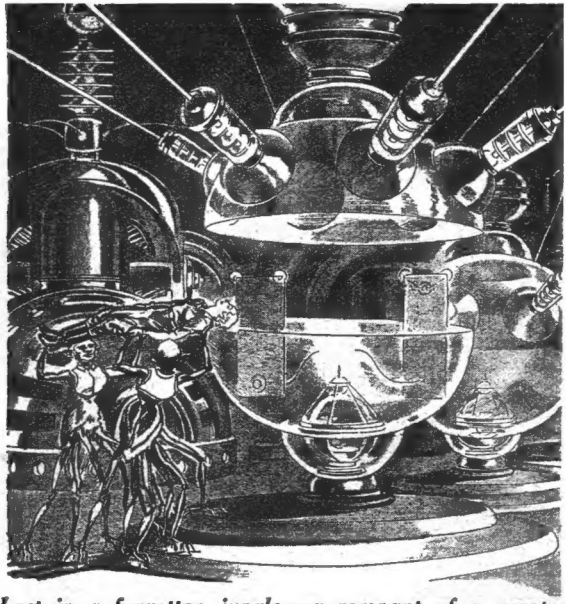


Lost in a forgotten jungle—a remnant of a greater civilization than Man's—in the hands of

The Degenerates

by
Polton Cross

HAVE you ever met a man whom you felt like hitting in the jaw? Such a desire rose in me when I first met Ludwig Reid. He was so smooth, so polite about everything he said and did that—to me anyhow—he was instantly stamped as a man to be wary of.

I met him first when Caspin Brook—the middle-aged millionaire owner of the

Brook Spacesuit Co.—called me over to his palatial place on Long Island. I was just resting from my job as astrogator to Trans-Plutonian Explorers and therefore open for any commission. Knowing Brook so well I scented something good and presented myself at his home on the evening of November 10, 2119.

As usual, he was full of enthusiasm. Tall and gray-haired, he had the keen eyes and hard-lipped mouth of a commercial giant and fighter. But Ludwig Reid, our sole companion in the library, was of totally different make-up—short in stature, with a remarkably square face, untidy black hair, and steady, pale-

"The matter projector needs a living subject of course, so——"

gray eyes that never left your face while he talked. All this—combined with a moon-whiteness of skin, long thin nose, and cruel, inflexible mouth—gave him all the attributes of a man of iron ambition, centered only on one thing—himself.

He was cordial enough to me at first, even though I felt like hitting him in the eye there and then. Brook introduced us in his swift, clipped fashion.

"Meet Dick Cambridge, Reid. The best free-lance astrogator in the business. With him as expedition pilot there'll not be a thing to fear."

Reid looked me over calmly. Evidently my six feet of space-hardened frame suited him, for he nodded slowly. When I shook hands with him I gave an extra powerful squeeze to express my dislike—but he didn't even wince. His sweetly odorous Titan-flower cigarette continued to smolder seductively.

"Delighted," he murmured coolly, releasing his hand. "I have invariably found that black-headed, dark-skinned pilots like yourself are better able to stand the free ultraviolet radiations of space. I think you'll do, Cambridge."

I nodded stiffly, but it was for old Brook that I did it. I'd do anything for him—and his daughter Ada. I glanced across at Brook.

"What's all this about, sir?"

"An expedition, Dick—to Io. Reid here has discovered a natural form of *ilution*—which as you know is at present used in an artificial form for space-suits. But Reid believes there are plants in the Ionian jungles containing the stuff as natural sap, and—well!" He laughed in his affluent fashion. "Reid and I will pick up multi-millions—and you won't exactly be left with a couple of cents if you see the thing through."

I looked at Reid quickly. "This on the level?" I asked him sharply. "I know most of Io, but it's the first time I ever heard of natural *ilution* trees in its jungles."

FROM his pocket he took two rolled pieces of substance like rubber and laid them on the library table. Both looked identical.

"Apparently no difference, is there?" he asked slowly. "And yet watch!" Fishing in his pocket once more he pulled out a nasty-looking knife that snapped open into a small dagger. With a swift stroke he drove the blade through the left-hand piece of rubber, and of course it instantly ripped.

"Ordinary *ilution*—the stuff we use now," he explained. "Now watch this——" He brought the knife down quickly on the second piece. The blade simply bounced off it and failed to make the least impression.

Wonderingly I picked the stuff up and pulled and tugged at it. It was absolutely untearable. Although identical to its torn twin on the table, it was clearly a hundred times as tough. The possibilities of such a substance—something the hard rock or the vicious surfaces of other worlds couldn't tear—dawned on me immediately. I didn't like admitting Reid was right, but I had to.

"I've had the stuff tested at my laboratories and it is absolutely unbreakable," Brook exclaimed eagerly. "You see the possibilities, surely?"

"Actually I got to know all about it by accident," Reid remarked, putting the knife back in his pocket. "An Ionian native named Kiol stowed away on the *Wanderlust* last trip up and brought some of this stuff with him. I've been to Io before and he remembered me. In fact he gave my name when he was apprehended by the space-port authorities and I had to bail him out. I'm glad I did! The moment I saw the stuff I saw the opportunity it meant for Brook and so got in touch with him right away. The site of these *ilution* trees is known only to Kiol as yet—but I do know the situation of the jungle clearing leading to them. It will take a skilled pilot to

lower into it, and that's why we sent for you. Understand?"

"When do you plan to start, sir?" I asked Brook.

"In two days. I've had a special spaceship equipped for the purpose, complete with maps, detectors, and all the usual stuff. Reid has had *carte blanche* to order what he needed—— You'll take it, won't you, Dick?" he finished anxiously. "It means everything to me!"

I nodded a rather slow assent. I had an odd idea at the back of my mind that Reid was up to something. Everything seemed logical enough and yet—— Well, I didn't trust the man. Good scientist and explorer he might be, but otherwise——

I was just leaving the great residence when light, tripping footsteps came swiftly toward me along the broad gravel drive. Ada Brook came quickly into the stream of light from the doorway, a slim, dainty figure in her speed-auto togs. The scarlet muffler round her throat offset the healthy pink of her cheeks and merry blue of her eyes. She tugged off her neat little wool béret and shook free a mass of golden brown hair.

"If it isn't Dick Cambridge!" she cried impulsively, wringing my hand. "Remember me? I'm Ada! You piloted the F-18 that time when Dad and I went over to Mars to study their lost civilizations."

"Of course I remember." I smiled. In truth I had never forgotten this impish bit of femininity. She has that art of doing something to a guy.

"I suppose you're taking this Io expedition along?" she went on eagerly. "Dad told me he was going to commission you. It'll be such fun! Did—did you accept?"

I nodded. "But I didn't know you were coming," I said quickly. "I'm mighty glad to hear it!" It would make all the difference to me—probably save me building up what were no doubt foolish suspicions about Ludwig Reid.

" 'Course I'm coming!" she pouted. "How do you think Dad would remember to take his vita pills without me around him?" She glanced quickly toward the house, then shook my hand again. "I'll see you again, Dick. I'm late already and Lud's expecting me to——"

"You mean Reid?" I asked grimly, and she nodded a trifle glumly.

" 'Fraid so. You see—we're engaged. It's a sort of business deal, really. Since he and Dad are to be partners, I—— Well, *you* know!"

I nodded bitterly and watched her go up the steps. Her, with her twenty-two years of freshness, engaged to that space-cold creature—— Now I was certain I didn't like him!

II.

WE TOOK off right on time two days later, and it was certainly a joy to be the chief astrogator of the *Stardust*. She was a pip—the sort of vessel only a multimillionaire can build, and a space hog can dream about.

Apart from Ada, her father, and Reid, we had my close friend Nick Charteris as second astrogator; a Chinese cook by the name of Hu Ling, and Kiol, the Ionian. Like any other native of the hot little Jovian moon he was very tall—seven-feet-four—with a very nearly naked, blue-skinned body, hairless head, large eyes to cope with mainly varying lights, and a rather absurd little mouth.

He kept mostly to himself, timid as all Ionian natives are—afraid of harsh words, yet on occasions mercilessly vindictive in avenging a fancied wrong. Poor old Kiol! He took to the vessel's rocket belly and stayed there in the gloom, only emerging for his special meals. Besides, the terrific strain of earth gravitation had pretty well exhausted him.

Until at last Io emerged from the nine-moon tangle around Jove. Here the real work began. Jupiter reaches out a terrific field of attraction for nearly 5,000,000 miles, and since Io is only 300,000 miles from his center, it demands a good deal of juggling with the jets to land square on any of his moons. Mainly for this reason Io, Ganymede and Europa are trading satellites used for their production of minerals and special plants. Callisto—being much farther away from the primary—is a frozen waste. Except for refueling purposes on the main Pluto run, all the moons are out of the main tracks.

We accomplished our purpose by firing our right forward blasts against Jove to break his influence, then we gradually moved inward until at last the gages showed the faint pull of Io was holding us. Faint indeed—for Io is only 2,320 miles in diameter. Once we got below his occasional clouds things were easier.

The landscape was a fairly familiar green tangle, bathed through the cloud rifts in the multiple lights of Jupiter, Europa, Ganymede, and the distant, disclike sun. Since Io also revolves in 42 hours the light effect is even more complicated on his surface.

We crossed the main Sawback Range, near the imaginary equator of Io and separating the unexplored jungle side from the *ithtick* rock quarries. Deep in the quarriers were the small huts of the guardsmen—only controllers and lawgivers of this god-forsaken penal settlement where criminals rot out their bones in a temperature rarely dropping below 120° F.

Beyond the quarries again, seeming small and squat, reposed the Io fueling center from which most Earth-Pluto vessels get their supplies before starting on their long journeys. Obviously Kiol, in stowing aboard the *Wanderlust*, had done so from that very place.

REID had me fly in a great circle over the jungle while he studied it intently through binoculars. He stood at the main spacescape window with his powerful legs spread wide to brace himself against the ship's circular motion. Beside him stood Ada and her father, gazing eagerly down.

"There!" Reid cried suddenly. "According to Kiol that's the spot. That T-shaped clearing——"

I looked down, too, and frowned. A T-shaped clearing was distinctly visible, with the dim silvery gleam of a river passing across one end of it. The rest was dense, mysterious jungle.

"Can you lower into that clearing?" Reid asked curtly, half turning.

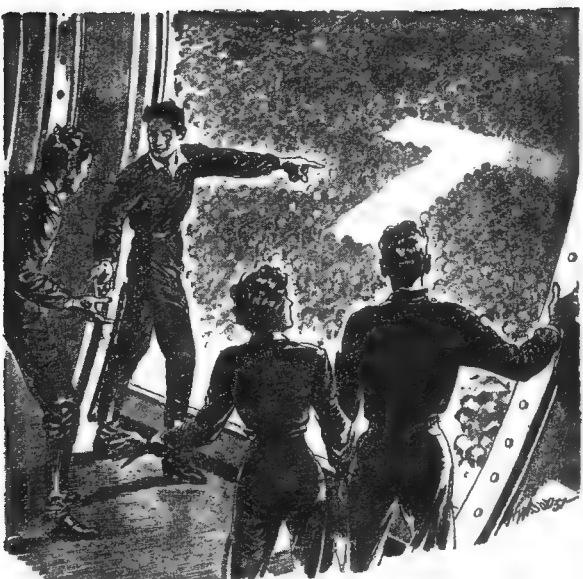
"I think so," I said, and set to work with the underjets, signaling instructions to Nick as he kept a counter-check in the rocket-control room below.

Because Io's attraction is only a third of Earth's, the landing wasn't half so difficult as I'd expected, but most of it was done blind. The lower we sank, the less we saw, because of the blast shooting down below. Its terrific heat incinerated everything beneath us and made that clearing twice as big in about forty seconds.

Little by little we sank, wabbling ever so slightly from side to side, but never once falling into a fatal drop-spin—that is, when the jets strike obliquely instead of direct. The float-level stopped on even keel, and at last the gentle thud quivering through the vessel announced our arrival.

I cut the jets and looked round. Brook smiled his silent congratulations. Reid said nothing. He stood gazing out on the vision of lacing jungle bordering every part of the clearing, the river now crossing its center, so widely had we enlarged the area.

In silence I turned to the compressors and switched them on, their function being to adapt the ship's atmosphere to the exact density of that outside. The



"That T-shaped clearing—the trees are near there."

gravity plates, too, were slowly weakened. In all, the process took two hours and produced plenty of sick bouts—but at the end of the time we were all outside, gazing round.

It was saturatingly hot—steamy, fever-ridden, lit by a variety of shifting lights. The sky was now dark-blue to purple, visible in the clear patches where the fantastic shaving-brush trees thinned out a little. These ridiculous growths shoot up to four hundred feet and more, thriving in a third less gravity than Earth and a dank, hot air. Our clearing was nearly circular now—thanks to the blasting of the underjets—and the swift river coursing into the jungle's depths went right across the middle.

Reid stood regarding it for a while, then turned. "We'll have to pitch camp on the other side of the river. Somewhere in the jungles over there are the trees we're looking for. That right, Kiol?"

The Ionian nodded his shiny head. When he spoke it was in the broken English he'd learned from the traders and penal warders.

"Remains twelve miles south, maybe," he jerked out flutily. "Soon make it."

"You'd better get the tents and equipment out," Reid ordered in a clipped

voice. "You too, Ling. We'll be too cramped in the ship."

The Chinaman and Ionian entered the ship's airlock, keeping well away from one another. It needed no imagination to see they were anything but friends.

I turned to Reid sharply. "What was that remark Kiol made about 'remains'?" I demanded.

"Poor English, I imagine." He shrugged indifferently. "Why?"

Since I didn't answer he turned and looked at Ada.

"Well, my dear, how do you like Io?"

"I don't!" she answered, fanning herself languidly. "It's about the most ghastly place I've ever encountered."

He smiled rather coldly. "You'll get used to it in a week or two—that is, if you don't get moon fever."

I trembled to hit him. He said it as though he really wished she would get fever. The remark left her untroubled, but it sent her father inside the ship to find quinine and *galpha* tablets.

In two hours the ship was unloaded.

OUR CAMP, when pegged out, comprised six tents, including an extra large one to serve as a dining and general room. All—with the exception of Hu Ling and Kiol, and Nick and me—had tents to themselves. I doubted the wisdom of putting Chinaman and Ionian together—if anything it would only serve to increase their dislike for each other.

Once our first meal was over Reid strolled some little distance from the camp with old man Brook and they stood talking and looking down the swift river as it coursed into the fantastic jungle. I made it the opportunity to take a walk with Ada and show her the wonders of the Ionian sky and landscape.

To me, the sight from a near-by kopje was not new, but it brought a cry of amazed awe from Ada's lips as we came to the top of the rise. On every side of us stretched that wild jungle with its dominating shaving-brush trees. Here and there the queer rocket-birds were in view, hurtling up like bullets against the light gravitation. Then when they reached the shallow air 800 feet above ground they opened a membranous umbrella and dropped softly down again. Their prey, in the main, consists of hurtling insects.

In various other directions were the treacherous calcium areas—some of them inert, but others bathed in lambent, flickering fires as the calcium united with ammonia gas from rifts in the ground and produced the swift light of calcium ammonium. Io is particularly rich in calcium.

The sky, though, was the main thing that held our attention. Jupiter hung directly above us—huge, yellow, overpowering, with the oval of his Red Spot moving slowly as his enormous bulk turned. Close to him gleamed brilliant little Ganymede and Europa. Farther away still—disclike and absurd—moved the Sun. Added to this were the hosts upon hosts of stars spewed in a myriad glittering dusts across the dark-purple heaven. It was superb—engrossing.

Ada talked of nothing else on the way back, when the trees hid most of the sky from sight—and, as she was talking, something happened. Something puffed in front of our faces with dangerous closeness, so close indeed that Ada jerked her head back and then stared in alarmed wonder at the pineapplelike bole of the shaving-brush tree close beside us. Immediately I went up to it.

To my utter amazement I saw that the missile had been a dart! I tugged it out and stared at it in bewilderment, trying to figure how the devil such a primitive thing had even gotten into this wilderness—even more so who had fired it. Twisting round I stared into the moon-and-primary-light, but nothing was visible. The lower tickle-brush grasses waved silently in the hot, sickly wind.

Ada gazed at the dart with alarmed eyes, then as she reached out her hand toward it I slapped her fingers sharply.

"May be poisoned!" I warned her quickly. "Take it easy!"

Slowly I turned it over, and in doing so I saw something I could hardly believe. The tip of the dart was tempered *jilian* steel! Actually *tempered*. Yet Earth chemists can't get the stuff to melt under 8,000° C. I happened to know they'd been trying it ever since the stuff was first discovered in ore form deep in the Martian deserts. The rest of the dart was ordinary shaving-brush wood stubbed with rocket-bird feathers.

"What's—what's the matter, Dick?" Ada asked anxiously, seeing my startled expression.

"Let's get back to camp!" was my abrupt answer. I was feeling decidedly worried.

IN TEN MINUTES we were back, but the rest of our party had retired to their tents. Reid was still up, however. I could see his shadow on the tent canvas cast by the portable gas-glow light on his table. I left Ada and went in to him.

"Reid, I want a word with you," I said brusquely.

He straightened from a survey of a map on the table and looked at me coolly. The desk light made his eyes look like colorless marbles.

"As many as you wish," he assented easily. "Sit down." He lighted one of his Titan-flower cigarettes and watched me through the smoke. Without any trimmings I shot the whole story to him and finished up by flinging the dart on the table.

"I demand that we all be supplied with flame guns!" I finished grimly. "It obviously isn't safe to go wandering around unarmed in this place—much less so with things like this flying about. We've got enemies! And how the devil did that dart get a *jilian* steel tip? I thought that particular ore belonged solely to Mars. Do you realize that Miss Brook or I might have been killed?"

He shook his dark head. "I think not," he said, quite unperturbed. "This dart is not poisoned, nor was it intended to kill. It was more in the form of a warning."

"A warning!" I echoed blankly. "A warning against what, I'd like to know?"

Without answer he went on slowly, "There is no need for arms on Io, Cambridge. I should have thought you'd know that. There are no dangerous animals—only the underbrush bugs and rocket-birds, and they're harmless. Furthermore, I don't think it prudent that any of us should have flame guns. Suppose one of us got delusion fever? It's a not uncommon symptom of straight moon fever. Suppose Hu Ling got it, for instance? Why, he'd murder the lot of us!"

"I'm not Hu Ling, and I'm not liable to get fever," I said bitterly. "Give me a gun and quit playing around."

He took up the dart and turned it over slowly in his long, sensitive fingers. Suddenly his eyes looked at me steadily.

"I cannot grant that request. I thought I had made that quite clear."

"Too damned clear!" I exploded. "There's something phony about this whole expedition, and you're the only person who can explain it. I insist on those guns, for the safety of the entire camp. Especially for Miss Brook. At least she oughtn't to be jeopardized—especially as she's your fiancée!" I couldn't help the bitterness I got into that last line—but his moon-white face didn't alter in the least.

"I'm quite aware of our engagement," he said softly, "but after all, Cambridge—I *am* the leader of this expedition. You are a little overwrought by this experience. Suppose you remain what you are—an astrogator?"

From the way he said it, I might have been an animalcule. I quivered on retorting—on demanding to know about the dart tip—then realizing that if I hit him it might lead to complications, I swallowed my fury and stalked outside. I felt his pale eyes watch me go.

III.

AS I moodily returned toward my own tent I encountered Hu Ling moving silently toward me. He gave his little obeisance. "Mister Nick would converse with you," he said smoothly.

I nodded shortly and headed for our tent. Nick was sprawled on his bunk as I entered. Immediately he sat up. "Ling found you then? Where'd you go? I've been looking for you."

For a moment I hesitated, then—— After all, Nick was to be completely trusted. Briefly I told him what had happened.

"I—see," he mused slowly. "Matter of fact it was about guns that I wanted to see you. I don't feel safe being unarmed with that guy Reid around. He's the nastiest bit of work I've seen in a year of moonrises. So it seems to me that the only way to get guns is to take 'em. To-night."

"But there's never any night on Io," I reminded him.

"I know that—but Io has a 42-hour revolution and that means that in roughly two more hours the Sun and Jupiter will both be out of sight. That leaves Europa and Ganymede light to worry over, and they're not very strong. Pretty low albedoes—— I think I could make it across the river to the ship without being noticed."

I nodded slowly. "O. K. It's an idea. I'll keep watch while you——"

I stopped short. Both of us twisted our heads sharply at a sudden wild shriek from the clearing outside. Immediately we were at the tent opening. Reid, Ada, and her father also came into view. The only other person in sight was Hu Ling, staring steadily toward the bushes. A jackknife glittered wickedly in his hand.

"What's all this noise about?" demanded Reid, striding toward him. "Was it you, Ling?"

The Oriental started out of his immobile posture. "The blue-skinned infidel attacked my honorable personage. I will not be defiled by the scum of this moon——"

Reid's jaws clamped shut for a moment then turning to the jungle he shouted Kiol's name. Amidst a rustling of tickle-brush the Ionian slunk into view. Reid eyed him with a cruel stare. "You attacked Hu Ling?" he asked tonelessly.

"No agree in shelter," said the Ionian helplessly. "We not fitted to keep company——"

Reid didn't let him finish. Swinging round his fist he struck Kiol in the chest. Since Reid was a powerful man on Earth with three times normal strength on Io, the blow sent the native hurtling backward to the ground where he lay whimpering in fright.

"You'll have to learn that while you're in this company you must keep your hands to yourself. You are only an Ionian native—we are Earthlings, no matter what our color." Reid stopped, then spat out, "Get back in that shelter! Quick!"

"Just a minute!" It was Ada who moved quickly forward and placed her slim body defensively in front of Reid as the Ionian slowly rose. She went on hotly, "You've not the least right to treat Kiol like this, Lud! It doesn't matter what world he belongs to, or what creed. Quite probably Hu Ling had just as much to do with it!"

THE CHINAMAN'S slant eyes smoldered a little brighter in the moonlight, but he said nothing. The rest of us closed the circle as the girl went on

talking, her voice now cutting with anger.

"At least I know now what sort of a man you are, Lud!" Deliberately she turned her back on Reid and nodded sympathetically to the Ionian. He looked at her steadily for a moment, unmistakable gratitude in his eyes, then nodded toward the jungle.

"Sleep there—more natural to me," he said briefly. "Come back in few hours."

"You'd better!" Reid ground out. "Be here with the rise of Jupiter——" He turned to the white-faced, rigid girl as the native crept away into the lofty grasses. "Most heroic of you, my dear," he murmured, smiling faintly. "Perhaps you forget that I understand natives far better than you. To allow another world native to attack an Earthling is to admit the lowering of interplanetary prestige——"

"Be hanged to your prestige!" the girl flamed back. "Kiol has feelings just as you and I—if you've got any feelings, that is! You acted like a—a brute!" She flashed him a biting glance then turned and strode back to her tent. Without a word we others broke up.

For a long time Reid stood thinking, stroking the lapel of his immaculate white coat. Then at last he returned to his tent. An hour later his gas-glow light went out.

"O. K.," I murmured to Nick. "He's doused the light. Now's your chance."

Quickly he kicked off his boots, stripped to the waist, and slid softly into the river at the clearing's edge. I watched him go, his head like a blob in that silvery ribbon, dimly saw him reach the other side and move quickly to the gray ovum of the spaceship. In fifteen minutes he was back, bitter-faced.

"No dice!" he snapped. "That damned Reid has locked up the arms cabinet. I don't like it, Dick!"

I hardly answered him. Somehow his discovery seemed to confirm my worst suspicions. I sat staring through the tent opening across the shadowed clearing, trying to imagine what possible purpose the cold-blooded Reid had in mind.

I fell asleep thinking about him.

When I awoke, Jupiter was just pushing his rim over the horizon. I looked around for Nick, but instead of finding him I discovered a note pinned to his bunk. It stated briefly that Reid had set off upriver in a motorboat with Kiol to look for the *ilution* trees, and that Nick had decided to follow him in another boat in an effort to discover what his game was.

"The damned fool!" I breathed bitterly, crushing the note in my hand. "If Reid's the man I think he is and sees you you'll never get back to this camp alive. And unarmed, too!"

That was the main thing that worried me. Nick was the kind of reckless guy who'd do anything. His only source of protection was a jackknife!

Small wonder that I was jumpy through the hours that followed. I hardly answered any of the questions that Ada directed toward me after we'd finished Hu Ling's most excellent breakfast.

"It's Nick," I explained, when she finally cornered me staring anxiously up the river. "He followed Reid."

She looked surprised. "Well, is there anything wrong in that? After all, we're bound to know where the *ilution* trees are one day, and——"

I turned quickly to her. Her pretty face was puzzled in the queer light. "Listen, Ada, do you really believe we came here for rubber trees?" I asked seriously.

"Well of course! What else should we come for?"

"That's just what I'm wondering," I

muttered. "The more I think of it, the more I believe that Reid planned this whole expedition as an excuse to get here. It takes plenty of money to equip a spaceship and for some reason he——" I stopped and looked round impatiently as Hu Ling appeared before us. His yellow face was troubled.

"Quickly, Miss Brook! Your honorable father is ill!"

"Ill!" she cried, startled, then we turned together and went quickly into Brook's tent. He was lying flat on his bunk, breathing noisily, his face a delicate green hue that wasn't altogether caused by the shifting lights.

"Moon fever," I said cryptically, instantly recognizing the symptoms. Turning to the anxious girl I said, "Fetch me my kit from the tent. You can go, Ling. There's nothing you can do."

FOR THAT MATTER there isn't much anybody can do with moon fever. It gets you right away, lays you out flat —and you stay flat until the crisis wipes you out or you recover with startling suddenness.

I gave the magnate an injection of *galpha*, made him as comfortable as possible, and left it at that. The attack might last anywhere from a few hours to a few Earth-days.

"No use worrying, Ada," I said to her, as she stood moodily outside the tent. "He'll be all right."

She nodded despondently. Worry for her father and my own worry for Nick's safety kept up apart quite a deal, and at the end of several more hours we were a pretty morose pair. But at least we had diversion by the return of Reid from upriver, accompanied by the Ionian.

Instantly I was all anxiety, looking for Nick. There was no sign of him. Striding across the clearing I intercepted Reid as he was about to enter his tent. I noticed that he carried in his hand a container full of rubbery-smelling sap.

"Where's Nick Charteris?" I demanded stonily.

He raised an eyebrow. "Should I know?"

"You know damn well you should! He followed you upriver when you set off. He hasn't come back."

"Really?" He meditated a moment, then shrugged. "I wonder if you'd mind coming into the tent? This sap is a trifle odorous." He turned deliberately and entered, switching on the gas-glow light. Putting the pot down on the bench he lighted one of his eternal Titan-flower cigarettes.

"So Charteris followed me, did he? For what reason?"

"Because, like me, he thinks you're up to something!" I said bluntly. "Seems mighty queer you didn't see him——"

"Well, I didn't! Nor do I like these constant innuendoes!" For a moment he looked at me nastily, then smiled disarmingly. "After all, Cambridge, I am sure you are worrying yourself quite needlessly. There are no dangerous creatures in the jungles and one has only to follow the river to get back to camp."

"You stand there and say there's nothing dangerous, and yet darts get thrown around?" I cried hotly. "That isn't very convincing, Reid. What's more, I don't believe you! What's behind all this? What have you done with Nick?"

He was still smiling cynically. "Your concern is most touching, Cambridge, but I can only repeat what I've said. And now if you'll be so good as to leave me I have work to do with this *ilution* sap."

He turned very definitely to the chemical bottles on the bench. I swallowed hard in my throat and longed to punch him in the jaw. Then I growled out, "Mr. Brook's ill with fever."

"At 120° F. that's not very surprising," he murmured, preparing to remove his white coat.

I stared at his back. "You mean you're not even interested enough to go over and see him?"

"Why should I? What can I——"

IT was Ada who cut him short. Her worried, frightened face appeared suddenly in the tent opening.

"Come quickly, both of you! Nick's boat is drifting downstream but there's no sign of him. I think the boat's got something heavy in it."

I was outside in a flash, vaulted the distance to the river edge in two leaps and stood staring fixedly at the stretch. Ada was right. A silent motorboat was drifting along, but weighted as few things on Io are weighted—so much so the boat's top was nearly level with the river.

Wading into midstream I grabbed it as it came floating within reach, tugged it quickly to the bank. Dazedly I stared in its bottom. Ada's breath caught quickly as she looked over my shoulder.

Nick was lying there all right, but something had happened to him. It was just as if he was a stone statue, an effigy of himself, and when I slipped my hands under his shoulders I encountered hard, brittle heaviness! Even in such slight attraction it took me all my time to raise him.

Perforce we had to call Reid and he gave us a hand to carry that unnaturally stiff body into his tent. In the gas-glow light we could see more clearly—and what we saw sent a cold chill of horror down my spine and caused Ada to gasp and back into a corner of the tent with a hand to her lips.

Nick's face was frozen into an expression of utter terror. His lips were drawn back and fixed—gray and hard. His eyes stared like frosty balls. Every part of his body was cast in the same inflexible mould. Even his teeth had turned greenish.

"Why, he's—he's turned to stone! Petrified!" I screamed huskily. "Reid, do you see? He's petrified!"

He nodded very slowly. "He must have gotten out of his boat at one of the calcium areas—probably cut himself. The stuff entering his bloodstream in such undiluted form could easily transform him into stone——"

"And then he got up, walked to the boat, and lay down?" I sneered bitterly. "Be damned to that for a tale! Somebody *did* this, and if any man knows anything at all, it's you!"

He looked at me icily. "You're a damned fool!" he said flatly.

"Even if you didn't actually do it you're responsible!" I went on hotly. "You wouldn't let any of us have guns. Nick went with his life in his hands."

"That was his fault. I didn't ask him to follow me."

Reid paused a moment as Ada, evidently finding things too much for her, moved quietly out of the tent. I turned back to Reid with a glare.

"Now get this, Reid; it's time for a show-down! I'm not putting up with anything more like this. Bring out those guns and come clean on what you're up to. You're not hunting for *ilution*. You're hunting for something that only you and Kiol know about!"

He elevated an eyebrow toward the sap he'd brought in. "What would you call that, then?"

"I wouldn't know—I'm only an astrogator! Even if it is *ilution* in a natural state it's only a cover up for something else. Come on—out with it!"

For reply the pocket of his white coat suddenly bulged ominously. I saw that his hand was thrust in it.

"Get out!" he ordered stonily.

I looked at the pocket. I could tell from the outline that it hid a small but powerful flame gun. And I could tell, too, from the brittle, snaky stare in Reid's pale eyes that he meant those two words.

There was nothing else for it. I went.

IV.

AN HOUR later we buried poor Nick's remains in the soft, oozy ground beyond the main clearing. Reid recited a burial service that was clipped, heartless and brief—then he went back to his tent and had a meal brought to him.

I roamed around in moody silence, listening to the moans and cries of Brook as he reached the delirium stage of his fever. Ada wandered about alone, too, avoiding all company, so heavy was the general worry on her mind.

Since Kiol was missing, I presumed that now his particular work was done he'd slipped off into the jungle to rest. As for Hu Ling, he was only visible now and again as he came outside his cooking tent to throw away water and waste into the river.

I stood idly watching him on one of these occasions, trying to figure out some way of getting the truth out of Reid—then I suddenly stood upright. Hu Ling had uttered a gasping scream. His water pail floated from his hand and bobbed to the ground; he himself went over and over in a sudden frantic effort to remove something from his neck.

I hurled myself across the clearing, but by the time I'd reached him he was almost dead, yellow, trembling fingers clutching for the last time at a tiny barb protruding from his throat. He relaxed, became still.

Ada gave a little cry of horror and turned away, raced for her tent. Reid came up in the mixture of lights, drawn by the Oriental's last despairing cries. Our eyes met.

"What this time?" he demanded curtly.

"Ling's been murdered!" I lifted him easily in my arms and for the second time within a few hours bore a dead body into Reid's tent. He examined the body briefly then plucked out the dart with tweezers, staring at the end. He smelt it quickly.

"Cyanic acid," he announced. "Kills in about seventy seconds."

I looked at him murderously. "So it's another of your precious outfit on the job?" I breathed. "The same crowd that had a go at Ada and me——"

"Don't be absurd," he interrupted calmly. "This is only a sliver of wood, not a dart. Besides, only one person did this—Kiol. He could easily get at my supplies of cyanic acid in the tent here. Fashioning a dart and blowpipe would be nothing to him. Clearly it was revenge. He loathed the very sight of Hu Ling, as you may remember."

What was I to say? It was perfectly logical reasoning, and very probably quite true. Besides the dart was only crude; nothing like that other one——

"Listen, Reid," I said slowly, "Ling's death is perhaps explainable in the way you've said. But with regard to the other things——"

I broke off purposely, took him off guard. In one swift action, timing my leap exactly with the gravitation, I vaulted the table, grabbed him round the throat and bore him to the floor. The uppercut I slammed at him dazed him completely. By the time he'd recovered his wits I had his gun steadily leveled.

"Now you're going to spill something!" I snapped, with a pleasant satisfaction in my heart. "And remember it would be a pleasure to kill you if you try any tricks! It looks as though one murder more wouldn't make much difference anyhow! Get up, damn you!"

He got up, his face like marble. "I really see no reason for such violence," he said irritably, fingering his jaw.

"Spill it!" I ordered inexorably. "And be quick about it!"

HE SEEMED to hesitate, then shrugged. "All right, I'll tell you. Probably you'd know in any case in the

finish so what's the odds? Maybe you'll see how foolish you've been. Where do you imagine the lost races of Mars went to?"

It was a surprising question, but I answered it quickly enough. "Vanished under the sand. Anybody knows that. We've examined Mars from end to end and found their buried cities—traces of their vast scientific achievements and marvelous resources. We've even found broken Martian coins——"

"Coins! There you have it!" For once his pale eyes were gleaming almost fanatically. "Like every other scientist I have examined Mars. I have broken coins amidst my souvenirs. But imagine my feelings when Kiol, a native of Io, came to Earth and brought me a couple of darts with tempered *jilian* steel tips, the halves of several coins which roughly matched my own souvenir coins, and the story of a hidden city! The coins, of course, were not identical halves, but of same type. See here."

He felt in his pocket and produced two broken halves of a coin. Indeed they fitted roughly and were undoubtedly of Martian origin. He made to return them to his pocket but I snatched at them quickly—too quickly. They slipped from my hand and plopped into the sticky *ilution* sap on the bench, sinking instantly.

"It doesn't matter," he said. "You can see it's true enough."

I looked at him in bewilderment. "You're not suggesting that the Martians came to Io, are you?"

"Not all of them, but some did—probably a remnant who escaped from the red planet before it finally succumbed to the devastating effects of dehydration. They chose Io because it was best fitted for their purposes. The gravitation is not entirely dissimilar to Mars'. This world at that time would be rich and comfortable. Yes, they established themselves in what are now the jungles and remains of their cities are still here. Kiol saw them—and now I have seen them."

"Then that dart——"

"A Martian dart, obviously. In the interval of the ages these migrated Martians have lost nearly all their old skill and become degenerate, have reverted to the methods of the primitive. But the primitive doesn't match up entirely when they tip their darts with *jilian* steel! That was what gave me my first clue. There they have an art which we of Earth haven't even begun to master.

"Think then for one moment of the vast buried scientific secrets in that city of theirs—secrets far greater than those on Mars itself for the migrating people would naturally take their most valuable possessions. To-day I saw that city, guarded by a handful of degenerates. Most of the place is apparently automatic and requires no brains to keep it going. A glorious scientific and mechanical heritage left from a day of supreme knowledge——

"In that city are secrets beyond our knowledge—but among them are such solved enigmas as matter projection over a distance, super-telepathy, the release of atomic force, the tempering and fashioning of incredibly hard metals——

"Now you know what I'm trying to do. Trying to rediscover Martian science for the sake of Earth—wrest it from these degenerates who no longer need it."

"So that's it!" I said slowly, musing. "Then where does the death of Nick Charteris fit in?"

"I've already told you I don't know," he answered calmly.

EVEN THEN I didn't believe him—but I did believe the Martian migration theory. I'd seen the darts for myself.

"Then the *ilution* trees were just a gag to get here?"

He smiled twistedly. "There was no other way. I have very little money of my own. I knew Brook would never

fall for the idea of a Martian migration, but something up his own alley got him right away."

"But that piece of rubber you showed us?"

"That was genuine," he said, surprisingly enough. "I *have* the secret of untearable *ilution* rubber. As a matter of fact it is done by a chemical extracted from an ore which I found on Mars. I could have made plenty of money out of it, of course, but I preferred to defer it for a while and use it as a means to an end. To come here. That stuff in the pot there is ordinary *ilution* which I melted over a fire." He stopped and looked at me steadily. "Well, now you know. What are you going to do?"

I started to say there was little I could do but Ada interrupted me. She looked eagerly from one to the other of us, then said, "I think Dad's getting better! Come and look!"

I took her arm and we hastened across the clearing. The moment I looked at Brook I could tell he was better. He was sitting up in his bunk, rather breathless, but the greenness of the moon fever had left him.

"What the devil's been going on?" he demanded impatiently. "I don't seem to remember——"

"You've been ill—and things have been happening," I told him seriously. I thought the two murders better be kept quiet for the moment on the off chance of a relapse.

He made a wry face. "Ill!" he snorted disgustedly. "And after all the preventatives I took! Well, ill or otherwise, I want something to eat—and quick! Something good! None of that damned canned stuff from the ship."

"I'm afraid there's nothing else," remarked Reid quietly, coming in. "Unless, of course——" He fell to thought for a moment.

"Unless what?" Brook snapped. He had the fierce impatience of the moon fever's hangover.

"Unless one of us could kill a rocket-bird. Their flesh is as tender as turkey. Unhappily I'm not very good at game hunting." Reid looked at me suggestively. Certainly I knew more about the job than him.

"How soon do you want a meal?" I asked Brook, and he blew out his cheeks in exasperation.

"Right now, of course! I'm starving, man! And I want some coffee, too! Black!"

"I'll—I'll see to it, Dad," said Ada quickly, and went away swiftly to take Ling's place at the cooking tent.

"I'll do my best," I said. "I'll want a rifle, Reid."

We went out together, looked at each other silently.

"I hope by now we understand each other?" he asked slowly. "Now you see why I stopped any arms. Not only from the point of view of possible fever madness but because a chance Martian coming near this clearing might have got hurt. That might have released diabolical scientific forces upon us. See?"

I didn't, but I nodded. Handed him back his gun. "O. K.," I growled. "Maybe I was wrong at that."

"I'll get your rifle," he murmured, and went toward the river, unhooked one of the motorboats and went over to the *Stardust*. In ten minutes he was back and handed me an ordinary rifle.

"See you later," he said, in a voice that somehow struck me as peculiar. Then he turned back to his tent to make the necessary arrangements for the burial of Hu Ling.

I looked round the clearing, listened to Ada's bustling with pots and pans, the impatient shouts of her father, the creak of the table in Reid's tent as he hauled the dead Oriental off it. Then I turned and strode into the jungle, heading to the point three miles away where there was apparently a good nesting ground of rocket-birds.

Yet as I went I was uneasy. Why,

I did not know. The thought of Ada alone with Reid troubled me. Even more so when I realized that Brook would be unable to protect her. Moon fever leaves a fellow's legs like tapers for days afterward.

Besides, he was unarmed. Reid had the key to the arms cabinet.

V.

THE JUNGLE was completely silent as I moved swiftly through it, guiding my course like any other jungle expert by the position of the stars. Once you know Io's revolution and changing sky and moons it isn't difficult.

I chose a particularly fat specimen, sighted, and fired. The din of my gun boomed in the hot silence. The shot bird's parachute membrane collapsed and it dropped lightly to the ground. In five minutes I'd scooped it up from the moving, disturbed birds and headed back into the jungle.

But as I came within earshot of the camp once more I could hear Brook shouting hoarsely. Shouting for me!

Immediately I doubled my efforts, vaulted the last bush, and came into the clearing. It was oddly deserted in the pale light. Dropping the bird in the cooking tent I raced across to where Brook was hollering.

"What is it? What's the matter?" I panted, bursting in.

He gulped for breath. "It's—it's Ada! Reid went off with her a few minutes ago, along with Kiol. I saw it all from here and couldn't do a thing!" He clutched my arm. "He took her by force, Dick!" He panted. "Threw her over his shoulder, gagged her to stop her cries—but I saw them just the same. I can't understand it. They—they went upriver. Blast it, if only I wasn't so weak!" he finished in despair.

Without a word I raced out of the tent, grabbed a few tins of compressed food and a bottle of restorative and took them in to him.

"Get these inside you!" I said curtly. "You'll have to wait for your rocket-bird. I'm going after Ada. I damn well felt something like this would happen!"

"But what does it mean? Where's he taken her?" he demanded huskily. "I never thought Reid——"

"No time to explain now," I tossed out as I left, and in flying leaps headed for the river. Then at its edge I stopped. For one thing, Reid had driven a hole through the bottom of the remaining motorboat, and it was awash. For another, I had no idea where this Martian city was situated. And even on Io a thousand miles of packed jungle is pretty impossible to search in.

THE ONLY THING to do was to repair the boat and then take a chance. I had it out of the water in five minutes. In another five I was at work with tools repairing the four-inch rip in the bottom. I worked with a desperate, feverish intensity, the thought of Ada slogging all the time into my mind.

I saw it all now. Reid had engineered it very nicely from the beginning. He'd put Kiol and Ling together and favored their antipathy until at last the Ionian had killed for revenge. Then he'd undoubtedly been back of the death of Nick Charteris. And lastly the idea that I leave camp and look for food—— That had been smart! It had left him free to take Ada. But *why?* That was the thing that appalled and perplexed me.

I worked onward in a grim mood, wondering as I slammed home the rivets how I could possibly trail Reid upriver. Then a sudden movement in the bushes of the clearing to my rear brought me round with leveled rifle. To my amazement it was Kiol who burst into view, breathing hard, sweat glistening brightly on his blue skin.

For several seconds he could not

speak, only gulp for breath and motion back to the jungle. Then at last he got it out.

"Miss Brook and Reid—they back in jungle. City. Woman in ex-exchange for science. She help me one time. I escape and help her now. Come tell you. Have to hurry." He looked back over his shoulder anxiously.

My jaws snapped shut suddenly. I drove home the last rivet and pushed the boat into the river, tossing in my rifle. Racing to the cook tent I swept up some stuff and tossed a sleep-preventative tablet into my mouth. Returning to the boat I motioned to Kiol and had him leap in beside me. I took no thought for Brook. He was safe enough anyhow. The immediate job on hand was to locate Ada—before it was too late.

I drove the motor on our little boat to the absolute limit of its capacity, sending the craft chugging in a tremendous wake along the swiftly flowing river. Naturally, with a lesser gravity, we moved at a far greater speed than would have been possible on Earth.

Kiol kept his eyes fixed on the long vista. He hardly spoke at all, and when he did it was only to urge greater speed. That couldn't be done: we were going all out.

IT SEEMED an eternity to me. I never knew a river to stretch so far—but I found that we had actually been on the way for thirty minutes when Kiol finally signaled sharply and pointed to a lee of the bank. Immediately I pulled toward it, grabbed my rifle, and vaulted off the boat yards before it touched shore. Kiol came up beside me, pointing to a faintly defined trail in the shifting light.

"Through there—straight to city," he said quickly.

At top speed I jumped along it, vaulted the shrubs that loomed in the way and finally burst through the screen of vines at the top of the rise. Immediately I came upon my first sight of that forgotten outpost. It stopped me involuntarily.

In the light of Jupiter and Europa it covered perhaps two miles of a natural jungle clearing, at the most barren point of which I was now standing. In every direction loomed the crumbled ramparts of once magnificent architecture—eroded columns of stone, skeletal walls, their masonry crumbled into now-smashed streets that had once been picturesque.

I began to move forward, only to stop as Kiol suddenly cried sharply and dropped in his tracks. In horrified amazement I stared down at his head. Half of it had been incinerated!

"Kiol——" I cried hoarsely, then I broke off and twisted round at a smooth voice behind me.

"I shouldn't make any moves if I were you, Cambridge. Drop your rifle!"

It was Ludwig Reid, of course, standing just in front of the near-by bushes. On either side of him were two of the queerest creatures I'd yet seen. In some vague way they looked Earthly, but only in the faces. Their bodies were those of an insect, supported on eight bowed, powerful legs.

"The degenerates," Reid explained casually. "Men of Mars, no longer masters of the mighty intelligence they once possessed." He came up slowly as I studied them, his flame gun held at the ready. "I rather fancied you'd come along when I missed Kiol!" Turning deliberately he kicked the dead Ionian in the ribs, then with a sneer turned back to me. "You don't place much value on your life, do you, Cambridge?"

That was too much for me. In that moment my accumulated hatred for the man suddenly spilled over. I hurled myself at him with clenched fists—but I never landed a blow. Instead he anticipated the move and slid to one side, at the same time bringing the butt of his gun down with tremendous force.

Blinding fire burst soundlessly before my eyes.

AS I RECOVERED consciousness I realized that I was lying on cold stone in the moonlit ruins of what had once no doubt been a vast hall of scientific instruments. Indeed, the instruments were still there. I could see their shadowy outlines as I slowly opened my eyes and warily looked about me.

Very carefully I turned my head and saw a dim vista of huge, incomprehensible instruments crouched in the shadows. Most of them seemed to be intact, but in design they were quite incomprehensible. My main impression was that of titanic electromagnets, tubes, generators, vacuum globes, and other generalized material, all of which seemed to be linked by heavy cables to a huge switchboard at the far end of the place.

I turned a little farther, then the movement was arrested as an insect Martian merged out of the shadows bearing in his tentacled "hand" a cup of beautifully wrought *jilian* steel. In his other hand was one of his deadly darts, poised ready for an instant drive into my heart if I refused his advances.

There was only one chance, and I took it. I raised the cup toward my lips, then paused suddenly and gave a hoarse shout, pointing at the same time to the distant shadowy masses of machinery. As I'd hoped, the guards twisted round briefly, and in that second I hurled the cup's contents over my left shoulder. By the time they looked at me again I was simulating all the actions of drinking.

I "drained" the cup, handed it back, and waited tensely. I wondered whether I was supposed to drop dead or throw a couple of handsprings. It was Reid who supplied the answer. He came softly from some adjoining part of the hall and looked at me in grim amusement in the moonlight.

"Well, you begin to feel the hardening effects?" he asked pleasantly. "In case you're not aware of it you have just drunk a liquid containing inert calcium. In that condition it is odorless, but the moment it starts to mix with the hæmoglobin of the bloodstream it becomes an active element and changes your entire body to stone, in the space of perhaps an hour. Pleasant, isn't it?" He looked at me in unholy satisfaction.

"So it was you who killed Nick!" I breathed murderously.

"What else did you think, you fool? It was sheer mischance that Ada happened to see the boat containing his body. I rather hoped it would be carried unnoticed down the river and end up over the Sawback Rapids. Much better than leaving the body here for these Martians to examine."

"And now?" I whispered, at the same time carefully feeling the weight of the stone slab on which I sat.

"Now you will watch these dumb heads give up their secrets. They know a little English—enough for that, anyhow. Here in this hall they have all the machines I've dreamed of. The actual knowledge is long since gone from their minds, but they still remember how to use the major switches which set the machinery in action. Here we have the source of *jilian* steel tempering, matter projection over a distance, and a hundred and one other things. The matter projection is particularly interesting, but to demonstrate it it is necessary, of course, to have a living subject. I could find only one—Ada!"

I SAT STILL. If I simulated growing paralysis I might get somewhere. "You had no need to take her!" I grated back. "Anything would have done! Even a rocket-bird."

He shook his untidy head. "A rocket-bird is not ordinariy flesh and blood. The effect wouldn't have been the same."

"You mean you would deliberately kill Ada, change her into atoms, in order

to learn one of several blasted secrets that we're bound to discover on Earth in due time?"

"Ah, but when?" he asked doubtfully. "If I get the secrets first it will give me an enormous advantage. I told you once that I was short of money. I'm taking care of that from now on!"

He turned aside quickly and uttered a command. A distant door of the great hall opened and two more Martians appeared, carrying the unconscious form of Ada between them. In perfect silence, save for the scrape of their insect feet along the floor, they bore her to a device that closely resembled a giant vacuum tube. I saw a great semicircle of glass glint momentarily as it rose upward, then it clamped into place again with the girl inside it. In growing anxiety I noticed the anode and cathode poles at either end of the tube.

Still I sat tight and glanced anxiously toward the guards. They were by the wall now, watching me intently. Reid had turned away from me, his whole attention given to the scientific experiment he intended to note down. The other two Martians were moving toward the switchboard preparatory to closing the switches that, I presumed, would bring hidden energies to work and actuate the machinery.

I had two things only in my favor—the gravity, and the fact that I was supposed to be in the first stages of paralysis. From the rigid way I'd been sitting I think I fooled them into believing it. But with that gravity I had in consequence three times as much strength as on Earth. The only thing to do was to utilize it immediately. And I did, with a plan in mind beforehand.

SUDDENLY I sprang upward to my feet, clutching to the stone on which I'd been sitting. It was heavy in my hands. On Earth I couldn't have raised it. In one mighty sweep I lifted it over my head and hurled it forward with shattering force. The effect was just as I'd hoped. The two Martian guards, taken utterly by surprise, had not the time to dodge. The hurtling slab carved into their brittle, insectile bodies, snapped them in two and plastered them messily against the frowning wall behind.

With a cry of alarm Reid swung round and ripped out his flame gun, leveling it to fire—but I'd been expecting that. I dove into a flying tackle, bracing my plunge with my heels hard against the floor. The terrific thrust sent me hurtling into him and we both went flying six or seven yards, his gun sailing out of his hand.

Keeping my head, I clung to my original plans, leapt to my feet and vaulted clean over Reid's sprawling body. In an instant I'd seized his gun, swung it round and pressed the button. The tremendous blast roared across the hall and immediately incinerated the two remaining Martians at the switchboard.

Reid seized his chance to hurl himself upon me, snatched at the gun—snatched too hard and it went sailing away across the shadows. His fist came up and jolted me from head to foot. I floated backward with a spinning brain, contacted the wall and automatically thrust my feet against it.

I had a vision of him racing toward Ada, probably with some plan in his mind to try and complete the experiment—but he didn't make it. The force of my thrust hurled me upon him again, and this time I was ready for him. I clutched him with my left hand, jerked him upright, then with the full power of my right arm drove my fist into his face.

He shot backward as though fired from a gun, his face shining sticky red with the force of that three-times Earth punch. He steadied himself suddenly and whipped out that daggerlike knife of his from his pocket. Menacingly he came toward me as I measured him narrowly from the shadows.

He was an unlovely picture. The

blow I'd dealt him had smashed his nose, I think. I crouched, waiting for him to spring—and at last he did. But in that split second I stepped aside and brought up a terrific uppercut that made his jawbone soggy under my knuckles. The knife dropped from his hand. He came reeling drunkenly down from the lofty ceiling and, braced against one of the vast instruments, I slammed him again. The blow hurled him floorward.

Still unsatisfied I hauled him to his feet and drew back my arm for a final blow—but it wasn't necessary. That last blow on the jaw, driven with piledriving effect, had snapped his neck. He sank down in a limp heap to the floor.

For just a moment I stood looking down at him, breathing hard. Then I turned swiftly and smashed open the tube in which the senseless Ada was imprisoned. In a moment I had her over my shoulder, weighing no heavier than a child.

Stooping, I picked up the ray gun and turned away to run swiftly outside into the jungle, fearful that other Martians hidden somewhere in the city's depths might start a pursuit.

But none did. I can only assume that those four were the last of their race. I reached the river half an hour later and pushed off hastily into midstream.

OF COURSE, old Brook was disgusted about his *ilution* trees, until I made a surprising discovery. As we packed up for departure to Earth I came across that *ilution* sap in Reid's tent. To my surprise it had set to complete hardness, nor could I make any impression on it! I tipped it out of its pot and it stood in a solid block, perfectly transparent, but——

Suddenly I remembered those two halves of Martian coin that I'd accidentally dropped into it. By rights they should be visible—but they weren't! They had chemically amalgamated with the *ilution*. Immediately I called Brook and Ada and told them what had happened.

"But—but what does it mean?" Brook asked in astonishment.

"It can only mean one thing," I answered slowly. "Reid said he had a hardening chemical extracted from Martian ore. It can only mean that these coins are made from that self-same ore and chemically assimilate with *ilution*. The thing's simple in that case. On Mars there are countless tons of the same metal from which these coins are made. It can be bought cheap—though but for this accident we might have searched for years to discover Reid's secret. Obviously he didn't know the coins were the same ore, otherwise he'd not have been so casual about my dropping them in the *ilution*."

"You're right—dead right!" Brook breathed wonderingly.

ANACHRONISTIC OPTICS

An unusually well-told light science-fiction story

by a new author
M. SCHERE

I WAS digging fill for Dan Murphy that day and I felt pretty glum. Me, a handyman, working with a shovel. But Dan Murphy, all he's said was "Loafing again? Get down in the pit behind my house and dig enough dirt to finish that embankment where I'm building my storehouse. Remind me to pay you something." So I was digging. Dan Murphy owns the land my shack is on, and I wasn't arguing with him. But I was pretty glum.

The place where I was digging was a sort of round hollow about thirty feet across, where folks say there was a "powder mine" exploded in the Revolutionary War. But Miss Berzelius, down to the library, says the Revolution never came within fifty miles of Millville, and they didn't have mines then to boot. Anyway, it's easier digging there than on the level, so all day I filled my wheelbarrow and made Dan Murphy's embankment grow. I knew that if I went around the village I'd be bound to find something broken and I could spend a nice day fixing it. But Maidy was sore and between Dan Murphy and Maidy I was bound to make some money whether I liked it or not.

That's just how I felt along about sundown, when I dug in sharp and turned up a bone.

I picked it up, kind of scared, and a sort of button of shiny metal fell away. "Cheez," I thought, "a poor, dead Revolutionary soldier!" Then I turned up some more, very careful. Seemed as though they weren't human bones, after all, but neither was they any bloat-belly dead cow's bones like you find in the woods or anything like a cat's or a rabbit's. Some were awful crushed. When I got them all up it seemed as though they had been attached to a sort of backbone that actually seemed circular, about two feet across, like you'd taken that shark's-backbone cane Lem Adkin's grandfather brought on his ship from China and bent it into a circle but you couldn't see where the ends were joined. There was a long, thin skull with a funny knob at the end like a small balloon, but pretty badly crushed. In amidst the bones were bits of that metal and shreds of something like leather with tiny metal wires in it, as though whatever it was had worn clothes.

I poked around and my shovel hit something hard. It was a block of metal, very light, that was shiny as that chromium plate when I scraped the dirt off. It wasn't quite regular, but shaped like a sugar loaf twisted to one side. There was a notch on the bottom, and I dug up a block underneath with a

Dan kept fading and coming back faster and faster.

tongue that fitted right into the notch. I got interested and before it was dark I found a square of those blocks all around where the bones had lain, with others under them as though they were the top of a wall.

I went up the hill and told Dan Murphy about it. He was half-drunk as usual and was tormenting his poor hound with a lighted cigarette.

"Ah, bury 'em again! Hurry up, before they start stinking."

"But, Mr. Murphy, maybe it was a soldier fighting for George Washington."

He looked at me and I started to go out. Dan Murphy has pop eyes, very pale and sensitive to light, so in the glare of his stove he was half-closing them. He looked like a lizard. "Bury 'em!" he said.

I went down to the pit, and it occurred to me that he hadn't said anything about the metal. Old iron is worth a lot, these days, for killing purposes, and while I'm a God-fearing man it seems to me that what's in the earth, unbeknownst to the owner of that earth, is just God's bounty. I would transfer that old iron to my barn.

First I dug a little grave off to one side for those bones, and I'd put them

in and was wondering about making a little prayer over them, if I could remember one—which would help fix things up if taking that iron wasn't exactly right—when some one came through the woods. It was Dr. Meadow, with his butterfly net.

"Good evening, Joshua. Have you seen a *Heliconius charithonia* come by?"

"Reckon it's too dark to see even that big name, Doctor."

"Ah well, it is time to go home and sort the ninth generation of my fruit flies. I see you have a new occupation? We have much in common, Joshua. You are a handyman, and I am a handyman of science, interesting myself in all its branches."

THAT was very nice of him to say because he was once head of a college. I liked him because he always paid me well for fixing the pivots of his telescope that he'd break by falling asleep on it when he was up all night watching stars. He was a little man without a speck of hair on his head and no eyebrows. But he was very kindly.

"What's this!" he cried, peering at the bones in the last of the light.

I told him, meanwhile standing on the iron I'd unearthed so he wouldn't notice *that*.

"Just like Murphy," he grumbled. "No interest in life but drinking and building bad houses. That meteorite observation dome he built for me is falling apart. Bury them, indeed!" He jumped right into the grave and examined the bones. "Joshua, you've found something!"

"Funny, ain't they, Doc?"

He was shivering, turning a bone over and over. "Joshua," he whispered, "no animal now living on the Earth has bones like these!"

He was awfully excited. I helped him pack the bones into his big specimen [illegible] and he took them home. Then I went home and had my usual squabble with Maidy, but she shut up when I said I'd work that night. When it was good and dark, I dug up those blocks, a couple of hundred of them. They were arranged in a square wall, with a floor three blocks thick. One of the blocks on the bottom was hard to pull up; I tugged and tugged, and finally it came out and I saw that a long, thin strip of metal stuck down from the bottom. That metal was springy, quivering so fast it just made a blur. I thought I heard something buzzing inside the block, but I was pretty tired and figured it was my head. No one saw me cart them all into my barn. Maidy never went in there—she said I could make messes and clean them up myself—so no one knew I had a lot of old iron.

Well, I worked ten days to finish Dan Murphy's embankment—he being away on a job most of that time—and didn't have a chance to do anything with the stuff. Twice during that time Dr. Meadow came down to the pit and poked around for more bones.

He told me very solemnly, "Joshua, those were no man's bones you found. It was a creature with a great brain capacity, and not—not earthly. The composition of the bones is different. The shreds of cloth and metal are something new. I'm almost afraid to tell my colleagues about it. It's—uncanny!"

I knew he'd like to know about the iron blocks, but I needed the money and I kept quiet.

I finished the embankment one morning when Dan Murphy wasn't home. Without Maidy hearing me, I sneaked into my barn. I looked at those blocks. They were mighty peculiar—all fitted with little tongues and grooves, and some that could be slid a little on each other. Not one of them was squared on the edges. The lines of some were so queer you got dizzy looking at them. And they shone wonderfully. Maybe they were a real, precious metal, I thought.

I began fitting them together, just for fun. It was like doing a jigsaw puzzle. After a couple of hours, I had them the way I'd found them—a hollow cube, maybe five feet on a side, the floor three blocks thick. The main difficulty was with that one block with the long strip of metal, always vibrating. I couldn't stick it down through the floor of the barn, so I let it stick up inside the cube just clearing the top. It didn't fit perfectly. That blame strip of metal kept vibrating, flashing in my eyes, and I could hear that buzz again. When I got off and looked at the pile, it seemed to be blurry as though the whole thing were moving and yet going nowhere.

JUST THEN some one knocked on the door and I heard Dr. Meadow's voice. "Are you in there, Joshua?"

Well, I thought, I'd just have to trust him, and opened the door.

"I had to come and ask you once more if you saw anything, some configuration of the ground, perhaps——" He stopped short. "What's *that?*"

"That's what I found, all that metal. I figured Dan Murphy might have some claim on it and—well—I don't want you to think I'm a dishonest man, Doctor, but——"

He didn't answer. He went over and stared at that thing, blinked, touched it carefully.

"The bones were right in it, Doc."

"Lord!" he whispered. "Maybe it's a—a—the thing he came in! From another planet! Struck the earth too hard and——"

"Shucks, Doc."

He didn't seem to hear me. He went around and around the cube. When he was on the other side he seemed to be in a glittering sort of haze, and I saw by the way he looked at me that I looked that way to him.

"Think it's worth anything in the old metal market, Doc?"

"Old metal! Ye gods!"

Now, up to here, I know exactly what I'm talking about. After this, you've go to remember that a lot of the things I write are things that *seemed* to be but that any one who lives in New Hampshire can say downright well *are not.*

Dr. Meadow climbed into that cube and there seemed to be electricity flying around him, but he paid no attention. He put out a finger and touched the strip of vibrating metal——

And the whole thing and the doctor disappeared.

Maybe two seconds I stood there glory-thundered. Then I took a jump backward and let out a yell. I landed heavily on a loose floor board and the other end of it, that was under where the cube had been, jerked upward.

And the cube and the doctor were back in place and the doctor was climbing out of that thing as fast as he could.

He held on to me for support. For a while, he couldn't speak. And when he did it didn't make sense.

"Time! Time! Time!" he said.

"You better sit down, Doc. But let's get out of here!"

"Joshua!" He stood up straight, his eyes glittering. "It's a time machine! I moved in time! I stood in your barn, in the future! That wall, there—it was leaning much farther out. There was a new brace—there—to hold it. And—and—what are those stars?"

"The tinsel stars on the rafter? Why, we have a little tree every Christmas, and I get a star for it, and every year I put the star up there when we're through with it. Makes a pretty line. But now, Doc, you come out of here and don't talk that way."

"I traveled in time, I tell you! There were more stars—a longer line—— What did you do, Joshua? What happened?"

"Why, you touched that jigger and you and all the blocks disappeared. I

gave a jump backward and jarred this board, and you were back."

He got down on his hands and knees and inspected that board. I was getting alarmed for him. "Of course," he cried. "You jarred the whole machine and it brought me back."

I FIGURED I'd better tell him how I'd put in that vibrating stick backward. That made him happy; he said that then the machine must be askew, or something. He told me to guard it while he ran home and got a jigger with triangles of glass in it, with which he said he was analyzing the light.

"It works with light," he said in the kind of voice a preacher uses, talking of miracles. "That quick shifting from infra-red to ultraviolet, with the colors of the ordinary spectrum seemingly by-products of some ether-twisting process——" All of a sudden he grabbed my shoulders. "Get in there, Joshua. Count those stars! I want to see how far in the future it's set for."

I was scared to death. But the doctor hadn't been hurt, so I climbed in, edging away from that vibrating thing. He stood right where I'd been standing. I drew a deep breath and touched the metal. I didn't feel anything at all. A lot of tremendous colors blazed in my eyes and then I could see again—and the doctor was gone. The wall of the barn leaned far outward. There was a new brace. I wanted to lie down and die of being scared, but I remembered to count the Christmas stars. There were twenty-one, instead of seventeen. The colors flashed on again—and there was the doctor, the wall just leaning a little, no brace and seventeen stars. I climbed out and my knees gave way.

"Doctor," I said from the floor. "I'm going to give back all his metal to Dan Murphy. *I* don't want it!"

"No, no! This is the most marvelous thing science has ever seen! How many stars?"

"Twenty-one. But Doc——"

"Four years! Let me see—this is 1936, it's six months to next Christmas. We've no way of knowing how far past Christmas one is transported in 1940 ——" It's somewhere between four and five years." He looked at me strangely. "And if I hadn't jumped on this board, you would have been left in 1940——"

Well, I heard some pretty wild talking, that day and a good many other days to follow. Dr. Meadow was running in and out all the time, and what with Maidy being peeved about it and my worrying about his state of health it was a pretty wild couple of weeks. Not that I wasn't curious about those blocks—shucks, yes! But it did seem to me that a man was entitled to some common-sense explanation. Yet all I got was what Dr. Meadow figured out, and as that is all I can tell about it, here it is:

When something happens, say a man walking downstairs, it leaves an impression in light, a sort of picture. The light fades out and out and keeps going, about 186,000 miles a second. That is, the image of what happened is broadcast and if you had a suitable receiver and you were 186,000 miles away you could see it one second later. The universe is full of a constant jumble of images, more every second. But there's a great plan of creation that keeps them shifting to make room for others and none are ever lost. Moreover, if you can tune in on them, you can make a constant, palpable vibration in the ether and reconstruct the happening, in the flesh.

Now, these images go out in a tremendous curve and eventually get back where they started. In time, you'll have many curves curving around and around each other, but each passes the same point on a different plane of dimensions and they don't conflict. Each has a different length, breadth and width, set up according to different harmonic laws, together with other, unknown dimensions

which are interrelated with time. (That one's a jawbreaker.) The assemblage of queer-shaped blocks—of a special metal acting as an antenna to intercept the etheric time-vision vibrations—could carry one backward or forward in time by presenting the conditions at the time required.

RIGHT THERE is where I asked the doctor how it could re-create what hadn't happened. You can think what you like about it, but he insisted that everything *has* happened, in some previous, cosmic cycle, trillions of hundreds of years ago.

"All right," is what I said to him.

Anyway, this creature whose bones I found had either existed in the past or the future of the Earth, though possibly he also traveled in space from another planet. He miscalculated, or the blame thing got the better of him, and, bang! there was nothing but a small hollow in the ground and a dead creature.

The doctor was all excited about the way I'd put the thing together. Said he'd found traces of an original binding material, which once had held some of the blocks rigidly in place. With that gone, and the vibrating thing out of place, the machine might do some funny tricks. He said the heart of the machine must be in that constant, buzzing noise, where possibly the more complicated controls were located. But he didn't dare try to open it yet. He figured out that the vibrating thing, in its original position, must have been controlled by rays of light. He doped out some sort of queer searchlight (it didn't light, but he said the rays were invisible). But he just tinkered with all its wires and radio tubes and put off trying it. Said the thing might fly away and never come back.

"Suits me," I said. "When it gets so a man's afraid to go into his own barn to get——"

However, he gave me a tenner to rent the barn, and another five because I'd have to wait a year for a butchering calf. Poor old Daisy, our cow, was so upset by the goings-on that she wouldn't let Cal Osgood's blooded bull get near her.

All this time, Dan Murphy had been over to Alton putting up one of his rickety houses. As soon as he came back I hustled over to get paid for that fill I'd dug, knowing I'd have to catch him before he was too far gone on his regular between-jobs drunk. You can't tell what he's going to do, when he's soused. Once he came to church high as a kite, and before they could kick him out he had presented the missionary fund with five hundred dollars. But he didn't look generous, this time. He held a half-empty bottle and he'd killed that poor hound, at last. His pop eyes were full of ugly, red veins.

"I'll give you ten dollars," he snapped at me.

I took my life in my hands and said, "Only ten dollars for breaking my back for ten days, Mr. Murphy?"

He was very quiet for a minute, the veins in his eyes getting redder. Then he said softly, "I'm going to spin this bottle on the table. If it points nearer me, I'm going to beat you to a pulp. If it points nearer you, I'll pay you a hundred times what you've got in your pockets."

He spun it. The liquor dribbled all over. I stood there getting sick. The bottle twisted and twisted—and slowed—and pointed right at me.

My hands were full of sweat as I counted out a dollar and fifty-two cents. Without batting an eye, he went to his desk and wrote out a promissory note for a full hundred and fifty-two dollars.

"Sorry I haven't the cash now," he said mildly. "I haven't put in the date, as I don't know when I'll get over to the bank. But you'll have your money

within a week. Good-evening to you, Mr. Hanks."

"Good evening, sir, and thank you," I said in a daze.

AS I TURNED to the door, the bottle whizzed over my head and smashed. "You!" he roared. "I just remembered! Last time you were here, when I told you to bury those bones, you said something about some old iron. What was it?"

"Why—I—nothing about old iron, Mr. Murphy," I lied fast.

He started having an attack of hiccups and I got out. I had a hundred and fifty-two dollars! I dashed into the house but Maidy was gone—shopping. Dr. Meadow was in the barn, as usual, and full of excitement, I told him.

"How very nice," he said absently, and kept going over the blocks with calipers and a rule. After a while he turned and looked at me. "If I were you, Joshua, I'd put that money in the savings bank, then run ahead to 1940 and collect the interest."

"Shucks, Doc. I might meet myself coming out of the bank and then I'd set down and die for sure."

"Oh, no," he said, perfectly serious. "According to my theory, existence in one plane, on transfer, cancels——

There was an almighty pounding on the door and it burst inward. Dan Murphy came reeling into the barn, grabbed the front of my shirt and held his fist ready to bash me. He was howling, filthy drunk.

"You slimy, lying snake," he shouted. "I've remembered! You found a lot of old iron in that pit. Where is it?"

"Why, Mr. Murphy, you must be imagining things. You'd been having a drink or two that night and——"

He slammed me against the wall. "Don't insinuate that I get drunk, Hanks!" He reeled around and made a pass at Dr. Meadow, just out of cussedness. Then he saw the blocks. He jerked back and his popping, red eyes seemed to bore right into mine. "Silver!" he hissed. "Is that what you found in my pit, Hanks?"

When you've got me pinned down, I'm a poor liar. He saw it on my face. Luckily for me, Dr. Meadow touched his arm.

"Come, come, Mr. Murphy, this is not the part of a gentleman. The metal is not silver. I am using it in a scientific experiment and will pay you well. Considering that I've paid you for a worthless meteorite observation dome, you should relinquish your claim in the cause of science."

Dan Murphy laughed. When he laughs, people watch out. He pulled my wheelbarrow in front of the machine and said, biting his words, "Cart this stuff to my house!"

I didn't dare refuse. But Dr. Meadow walked right up to him.

"You can't do it!" the little doctor shouted. "I'll give you five hundred dollars."

"Cart it!" said Dan Murphy.

"A thousand! Two thousand! I'll—I'll mortgage my home, but don't touch that machine!"

"Cart it!" Dan Murphy said, louder, swaying and clenching his fists.

"No!" the doctor fairly screamed, and shoved me away from the blocks. "You'll take them over my dead body!"

"All right, I will," Dan Murphy grunted, and reached for the bald little man. He dodged away and I dodged with him, behind the blocks. He grabbed my garden hoe. I realized that Dan Murphy had us cornered, there between the blocks and the barn wall.

"I'm coming over to get you and I'm going to rip off both your heads," Murphy said, and started to climb right over the blocks.

The doctor and I let out a single yell of warning. Murphy stood right up on one edge of the cube, ready to jump down on top of us. He reeled around.

He kicked one block loose and it fell inside; his foot waved wildly and he fell after it. His shoulder hit hard against the vibrating ribbon of metal.

SUDDENLY he and the blocks were flashing out of sight and back again. We'd glimpse him standing with his eyes almost out of his head, then he'd be gone five seconds, then back with his mouth open, yelling, then gone and back and gone. It was awful. I lay down with my face to the wall and knew it was the end of me.

"Hurry, man!" the doctor shouted. He pulled me out from that corner. He jumped up and down on the loose board. All that happened was that Dan Murphy flashed back and forth even faster. When he stayed with us for a second, we saw that a dozen blocks were displaced. He tried to climb out, and zip! he was gone again. He didn't come back.

"The machine is gone," Dr. Meadow said, and sat down on the floor and held his head in his hands.

My brain was going like mad. "Why, Doctor, if what you say is true, then you just have to wait till 1940 and it'll be right here again."

He jumped up looking ten years younger. "Yes! Provided, of course, that the derangement of the blocks, while affecting its efficiency, has not changed the time-interval setting. We'll take that chance!" He grabbed for his peculiar searchlight. "But maybe we can bring it back!"

For two hours we worked like blazes. He fiddled with that searchlight and I ran to his home a dozen times for storage batteries and all sorts of gadgets. It was near dark when we got some results—a sort of hazy outline. Dr. Meadow fussed and fumed. I walked across the barn to get him his notebook—and I stepped on that loose board again.

There was a flash of colors. The outline had disappeared.

"Gone!" the doctor groaned. "It was partly here, and you caused some further displacement——" He stopped, staring apparently at nothing. "Wh—what's *that?*" he croaked.

It was shadowy and I saw nothing. I went closer, and the doctor's shivering finger pointed to something—to two objects, two inches apart, hovering six feet in the air——

I tiptoed away from them and I went slow and silently till I got behind the stall where I couldn't see them and they couldn't see me. Then I ran. I fell over the gate and lay in the ditch by the road. I died.

Leastways, I was sure I had, and I was so happy in the thought that I resisted when Dr. Meadow tried to pick me up.

"St—stay with me, Joshua," he stut-

tered. "We—we've got to work together. He's watching us!"

For those two objects hovering in mid-air were Dan Murphy's eyes.

If it weren't for the pitiful state the doctor's nerves were in, I would never have gone back to the barn. We sneaked in together and peered around the corner of the stall. Dan Murphy's eyes floated there in the darkness lit faintly by themselves, all the red veins showing—the whole eye showing as a little ball, no eyelid nor eyelash nor a bit of face around them.

I hardly recollect what happened during that night. The doctor figured and worked and tried one thing after another. But nothing happened. The eyes stayed there, turning this way and that a little, till I could feel the fingers of skeletons crawling up and down my spine.

"It's permanent," Dr. Meadow said in a tired voice at dawn. "Dan Murphy is in 1940, without his eyes. The machine is out of order. But my plane-modulus light had some effect. They prevented the time-warp, at the last moment, from affecting that part of his body most sensitive to light—his eyes."

I found that I was believing him. There was nothing else to do.

"Then what's he doing?" I asked in a voice I didn't recognize as my own.

"He is standing in the wrecked time machine, in your barn. At least I am quite sure he won't move, for he can see nothing in 1940. I *think* he can see here, now."

DR. MEADOW wrote in big letters on a sheet from his notebook, "Do not move. You will be all right." He held it up before the eyes. They shifted slightly till they looked right at it.

"Strange, that his eyes, now, can convey a message to his brain, four years hence, and his brain tells the eye muscles to move the eyeballs which are four years behind them—— But it is not impossible that there is a psychic connection transcending all planes——"

"Doc, maybe right now I'm walking into my barn, in 1940, and seeing him there without his eyes and dying of scairt!"

"No, Joshua, when the right day in 1940 arrives, you will find him with his eyes. For, if we take care of them, they will catch up to him."

"But how is he going to eat, for four years, Doc?"

"He is standing still in time. In effect, he is stretched over a period of four years. If he dies, the eyes will die."

A week later, the eyes were still alive and I was getting a little resigned to it. Dr. Meadow figured out how to take care of the eyes—spray them with a soothing solution every few hours and not let dust or any bright light get at them, most of the time keeping them in darkness.

By that time, the police were investigating Dan Murphy's disappearance. Dr. Meadow and I figured we'd just stay out of trouble, because it looked as though there'd be plenty of trouble from misunderstanding folks if we tried to explain. I just let an old sack hang from the rafters in front of the eyes, and no one saw anything when they came investigating up my way. No one missed him, least of all his housekeeper, and they figured he'd fallen into the river while drunk and got caught on a snag at the bottom. They couldn't legally call him dead, though, for seven years. By that time, we hoped, he'd be around again.

You get sorry even for some one like Dan Murphy when he's stretched four years long between his eyes and his head. Doc and I let Maidy in on the secret, gradually, and when she recovered she got to going to church very regular. She kept the secret, but she wouldn't come near the barn. Doc bought some special dust-proof cloth and

I rigged up a sort of box around the eyes to protect them.

I figured it would be awfully boring for Murphy, standing still and waiting for his eyes to catch up to him, so I've gotten in the way of letting him read a bit, every night. He had a lot of gushy love story books in his house—you can't tell what a man reads from how he acts—so Doc bought a couple of dozen more and every night I go into the barn, duck into the dust-proof box with a shaded lantern and a high chair, and Dan Murphy and I read together. You ought to see us—me squatting about four feet from the floor in the high chair; and the eyes, solemn and never blinking, floating over my shoulder and moving from line to line in a regular way. It was pretty dismal at first, but I've gotten used to it. He's just as good company as Maidy.

I THROW in an adventure or travel book now and then, and the city paper every week. Also, I've shown him a long, typewritten explanation the doctor got out, so at least he knows what's happened. Some day I'll get up my courage. If I put the Bible up there he'll ding well have to read it, even if he never would before.

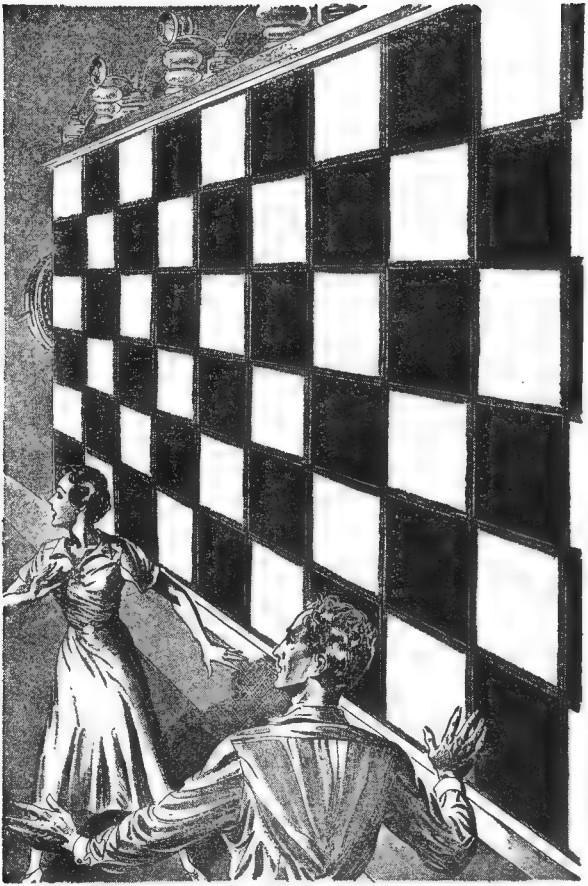
I've put two more Christmas stars up on the barn rafter. The leany wall got bad, and I put in a brace. Once or twice a week I go down to Dan Murphy's house and potter in the garden or clean the litter that blows around. I write him notes about it. People say I'm crazy, he's dead, but I tell them he was a fine man and some day he'll come back I write him notes about *that,* too. I'm going to get Maidy to borrow her nephew's moving picture machine, and I'll show Murphy some nice films. Doc has subscribed to a building trades magazine that I let him read. Doc figures he won't resent it and he may be a better builder when he gets back his eyes. I found a magazine with a lot of scientific stories in it and one about a man who traveled in time—but I'm not showing it to Dan Murphy. That would be too much like rubbing it in. You see, I want him to be in the best of humor, come 1940 and the day his eyes click into place and he steps from that awful machine. I want to be sure I get that hundred and fifty-two dollars.

The Fatal Quadrant

BY ARTHUR J. BURKS

A novel of Antarctica—and suddenly self-willed robots

I KNEW that scientists generally regarded Professor Sherman Geddes as the most brilliant of the moderns. I knew that he was ridiculously young—thirty-three—and that he was fabulously rich. The last of a great family, he had turned his inheritance into cash, with which, since he was twenty-seven, he had financed a round dozen expeditions into Antarctica. These expeditions were never exploited, and only a chosen few of Geddes' friends knew what, if anything, they had accomplished. As editorial writer for a huge string of newspapers I had tried a score of times to interview him. He had been polite but firm in his refusals. I resorted to letters, and he invariably replied at length. But the gist of his replies was



Another—outside—will had taken over. The four robots went out soundlessly——

always the same—he had nothing to say for publication.

One of those rare friendships, wherein letters were the only connecting link, sprang up between us. That we were the same age helped a great deal. I had the feeling, over a period of years, that if he ever broke his silence I would be the first to know about it, would get first chance at whatever he had to say. Even if he only reported his own doings, his own ideas, with telegraphic brevity, it would mean a series of articles that would run indefinitely.

He broke his silence at last with calm simplicity. A brief note came to my offices.

> My Dear Draper: I am making another expedition into the Antarctic, one to extend over a period of five years. It will be the most completely equipped expedition ever to penetrate that part of the Pacific Quadrant. It will be quite comfortable, though perhaps lonely. There will be three of us, if you care to go; Zora, you, myself. Please advise.
>
> (Signed) Geddes.

I thought of a lot of fantastic things before we started. I thought of them all after I had dispatched a note to Geddes, saying that I would not miss it for anything in the world. I knew Geddes had created—from its various components—life in the shape of various plants. I knew that he had made a heart that was, to all intents and purposes, human. But it had never been inside a human being. He kept it, according to rumor, in a glass jar, where it beat as steadily over a period of two years as the heart in a normal, healthy human being. He had done amazing things with mechanical men, going far beyond the usual robots described in feature articles in the newspapers and in technical magazines. He was fifty years ahead of his time in a vast number of things.

That much I knew, or thought I knew. But I didn't know who Zora was until we were aboard Geddes' flagship, one of three he was taking into the Antarctic with supplies and equipment. Zora was Sherman's sister. I disliked her from the beginning, mostly, I think, because I never could stand women who were obviously my intellectual superiors. Understand, she never made this apparent, nor seemed to realize it. But I did, which was enough and to spare.

I PASS over the voyage, and the hell we went through to make southing, the entry into the Bay of Whales, and of the struggle over the Ross Sea Shelf. Those places have been described plenty of times by more experienced explorers than I. My story really begins at our camp, scores of miles deeper into Antarctica than anybody had ever gone before, deeper even than Geddes' own men on previous expeditions—and the least of them had excelled the best done by any other expeditions. Geddes, of course, was in possession of all data gathered by all previous explorers and did not hesitate to make use of their observations in planning his own camp.

There were two huge cases which he watched over like a hawk. Nobody had seen what was inside them except Geddes and Zora. His men were curious about them, but did not ask too many questions. They were paid to forget whatever they saw and heard.

It was not until we were comfortably established, not until the last of his men had retreated to the sea, there to embark for the United States, that Geddes prepared to satisfy my curiosity. Those crates had bothered me some. They looked so much like coffins, though each would have held the corpses of a score of men.

They were left on the floor of his technical laboratory, which was the largest, most complicated, ever put together anywhere. The main feature of the laboratory was a huge table, covered with buttons, in the center of the

vast room. Directly beyond the table, against the wall, was a panel which was almost the exact duplicate of the table, except that dotting it, making it look like a checkerboard set on edge, were thirty white squares. The table was all black. Both panel and table were intricately wired. Our electrical equipment, in an adjoining room, was the best available. Money could work miracles, and Geddes had spent it like water.

"Why not?" he smiled. "We'll be gone five years. We will have no use for money during that time. When we return I'll be so much richer than when I left that it will be scandalous."

I'd arranged for two-way radio communication with the outside world. We could, during all our sojourn, say anything we wished, to anybody anywhere, and listen to whatever went on in the world we had left. Buried in the ageless ice, with the temperature above our heads sixty degrees below zero, we could listen to singing in auditoriums at blood heat. Yet nothing could reach us.

Geddes, I remember, watched his men depart. He kept in touch with them by radio until they had passed beyond the last dangerous brigades of the drifting bergs. He was in a fever of impatience, all the time, too, which troubled me no little. Zora—I had to admit that the girl was attractive—kept him calmed down.

"You're going to be here five years, Sherm," she said briskly. "Surely a few days at the beginning can't make much difference. Mr. Draper will tell the world what you're doing, anyhow. So why be so secretive?"

Naturally I wondered about that, too, until it came to me that perhaps he wanted to make sure that his men were too far north to return before the ice closed in. By the end of the long winter night he could be so far advanced in whatever he planned doing that he couldn't be stopped. That was my hunch. I might have been wrong. As matters developed I was dead right.

"Now, Zora," said Geddes, when he finally got word that the ships were in the clear, heading north under full power, "it's time to put our crew to work!"

THAT rather startled me. Crew? What crew? There were only the three of us in Antarctica. But Zora knew, all right. She went to help her brother open one of those crates. I almost had heart failure, almost thought both of them stark, raving mad, when I saw for the first time the contents of that initial crate. It was filled with human corpses, stacked like sardines in a can.

My brain reeled. Overhead I heard the wild shriek of a blizzard that seemed to strike the minute the first of the corpses was exposed. I heard, near and far, the eerie movement of the ice, crackling, groaning, sometimes like the rushing of many waters, sometimes like the crack o' doom. The whole thing fitted in with this madness. But neither Zora nor her brother seemed disturbed. Nor did they look at me. I was supposed to take this horror as a matter of course.

I can still see the eerie picture, there in the vast laboratory, with those two people. Geddes' pale, slight, sensitive fingers working on the crate, eyes aglow as with some weird fever, dressed as he would have dressed in his laboratory in New York City, even to the white smock; Zora in light dress and shirt waist, sheer stockings, hair done just right, sensible shoes, hair raven-wing black, hands as sensitive as those of her brother—bringing the first of the corpses to view.

They stood the first three against the crate, side by side, and I noted something else that was queer beyond words. All three corpses—apparently stiff with the cold—were as like as peas from the

same pod. They were dressed alike, too, in clothing that certainly didn't look proper for the coldest spot on Earth.

"That ought to be enough, Zora," said Geddes. They both ignored me, worked with feverish haste, wrapped up in what they were doing. I think they'd even forgotten I was there. I was numb, watching them. I felt that my knees must give way under me, yet couldn't walk the dozen steps to the nearest chair. I could only stare, and wish my heart wouldn't make so much noise. Zora remained with the three corpses, while Sherman Geddes went to the table where all the buttons were, checked memoranda from a thick notebook he kept in a drawer, came back and examined the corpses, then returned to the table, pressed three buttons.

Those three corpses came to life! Just like that. One moment they were dead, utterly lifeless for all their resemblance to living persons; next moment they were standing on their own feet. At first I noted only that their eyes were opened, and that they gleamed with a peculiar brilliance. Then Geddes called to Zora and me, and we walked to the table, sat down where Sherman told us to. Zora's lips were parted with eagerness. My mouth probably hung open. Geddes was alight with an almost fanatical zeal.

He looked at me, smiled a little, noting my mystification for the first time, then turned his head in the direction of the corpse-trio and spoke in a normal tone of voice.

"You will finish the unpacking and assembling, working from the end of the crate already opened. Begin at once!"

THE CORPSES had been startling enough. But what they did now was even more so. They went to work with an efficiency and speed which made my hair stand on end. They used the tools that Sherman and Zora had dropped, and they manipulated them with greater skill than either of the former had. The shrieking of drawn nails sounded in the place. There were echoes as boards dropped to the floor. One of the corpses picked up the nails, straightened them with a hammer, carried them to a keg near the door, stored them there. Another piled the boards from the crate.

One by one other corpses came into view, each as like the first three as it could possibly be.

"You made a mistake, Sherm," said Zora. "How are we going to identify them when we can't see the numbers?"

"And how," I asked, "am I going to retain my sanity if you don't explain what all this is about, what those things are?"

Zora laughed softly. It was a nice laugh, though it didn't make me like her any better, because that superiority I imagined was in it. She knew. I didn't. That made her superior. I caught myself on that thought, however, for if I were to spend five years with these people I'd have to get along with them. I didn't—or at least hadn't—worried about Geddes in that respect, but now I wasn't sure. The man was terrifying.

But he looked like a young boy who had put one over on his elders. He ran his nervous fingers through his shock of brown hair, and laughed, showing firm rows of white teeth. I knew right then that he wasn't mad, no matter what all this portended.

"They're mechanical men, Jud," said Geddes. "Done in man's shape because I saw no reason for stretching the imagination to shape them otherwise. Nor did I make the usual nightmare contraptions of other robot-builders, not only because it wasn't necessary, but because they gave Zora the shudders. As matters now stand, she has thirty young men to keep her company!"

"You mean there's nothing actually human about those things?"

"I don't mean that at all. They're human, with some important details missing. They weren't born, they won't die. They can't freeze drown, get sick, smother or burn. They don't eat or sleep or get tired. They can do anything that man can do, which means that they can do things few men can do. A few hardy scientists, perhaps, might come close to emulating the things I intend for these gentlemen to do, but certainly never for the length of time I shall call upon these men to work. Each is possessed of a mechanical brain that is the best I could make it, the most nearly perfect. Each was done at the height of my own mental activity, and therefore each is my brain at its best and——"

That gave me a little shiver, I can tell you, for Geddes was the world's most brilliant scientist, which meant that these thirty creatures, these "Its"—whatever you call them—were all only less brilliant than Geddes himself. They simply lacked his drawback of *life*.

As each man was brought out, he was set up, automatically, and put to work.

"They can, naturally," said Sherman Geddes, "do anything. We have thirty of the most nearly perfect servants conceivable—who are at the same time the most intelligent scientists, the hardiest explorers, ever to be gathered together anywhere. They will cook, make beds, keep the place clean. They will wait on us. They will look after all our wants, from our shaving to Zora's hairdressing. And they won't talk back unless spoken to——"

I decided to try something. I pointed a finger at the nearest of the robots, shutting my ears to what Sherman Geddes might have been saying, and snapped: "What's your name?"

His answer came back instantly. *"It's Number Fourteen at the moment, Mister Draper, but if you'd care to suggest something else——"*

II.

IT WAS amazing how quickly I became accustomed to the unaccustomed. In two hours' time I accepted the mechanical men as I might not have accepted men of flesh and blood. Certainly I had no reason to complain of anything they did. As servants they were perfect. Geddes simply gave them orders, which they carried out tirelessly, in the minutest detail, while he and Zora plunged into their chosen work, seemingly with no further thought to their servants.

Away from us in all directions stretched vast fields of ice, roofed with zastrugi. In some places pressure had lifted great green or blue hummocks toward the sky, and even I knew that there was deep water under such places, though for the most part our ice field rested on the Antarctic Continent, immovable as the Rocky Mountains. Vast—deep—the mere thought of the ice was brain staggering. The time taken to build this ice-field must have been prodigious. I hated to think about it, even, or to speculate too much on what the ice might hide. I thought a few times of vanished Mu and Atlantis, but felt quite safe in that if they were under the ice their discovery would never come in my time. I thought of the great stone monoliths on Easter Island, and wondered if, perhaps, the secret of their origin might not be here somewhere. After all, in the Northern United States only twelve thousand years or so separated us from the Ice Age—and twelve thousand years wasn't a split second in the march of time.

Just what, I asked myself, was Geddes planning on doing here? What were his aims? That he would tell me in his own good time I knew very well. So I did a lot of reading in his library—mostly on Polar exploration—and watched his robots at work. He kept them busy, too. They did all the lifting of ap-

paratus. They did any work that required exit from our snug dwellings. They cooked, made beds. One even kept notes for Geddes. I looked at some of his writing, and it was like expert etching.

I avoided Zora as much as possible, at least at first, before the excitement wore off and I had a chance to become lonely. Sherman and Zora never seemed to get lonely. They were too concerned with their work. And I noted that they were gradually sending their mechanical men farther afield, usually when the air was almost still. Geddes explained that blizzards didn't make any difference to them, but that he could work more accurately if his men could see where they were going! All of which, at first, was absolutely Greek to me.

"But what are you doing?" I asked. "What are you after?"

He grinned at me. I studied his eyes. He must have read my thought, for he asked: "You're not quite sure of my sanity?"

"Yes, I am," I replied, "though there have been times, plenty of them, when I wasn't. But I'm still in the dark."

HE LINKED his fingers together and looked rather professorial. Zora came and sat down to listen, though I knew she knew all about it and had probably listened to her brother tell it all a thousand times.

"Jud," began Geddes, "do you believe that every mountain has a keystone?"

I stopped, trying to comprehend his question. Arched bridges had keystones, I thought, but *mountains!*

"Theoretically, at least," went on Geddes, "every mountain has a keystone, the removal of which would bring the mountain crashing down. That there is little likelihood of any such keystone being found doesn't impair the validity of the theory, does it? At least we can imagine finding the keystone of a given mountain, blasting it free, and causing an earthquake. For what man can imagine, man can do——"

"I don't agree to that!" I said sharply. "I can imagine playing One Old Cat with the planets, but I don't expect ever actually to do it!"

They both smiled at me, and I glared at Zora, because she smiled, I thought, the more condescendingly.

"You're not imagining," said Geddes. "You're just talking. You can't conceive of what you've just said, any more than you can conceive of a million people, all packed together or—to take Herbert Spencer's example—than you can stand on a seashore and see, mentally, the whole face of the Earth, out to the horizon and beyond it, clear around the Earth to your own back. So keep to what you *can* imagine."

I felt nettled, but I was out to get information, not to give it.

Geddes continued. "Every cyclone, every typhoon, every hurricane, every least wind has to have a beginning, doesn't it? Somewhere, Heaven only knows where, a wind begins. It's just a whisper, perhaps, but in the final analysis, before it blows itself out, it can turn an ocean into a maelstrom, sweep across continents, destroying hundreds, thousands of lives, devastating its entire pathway. Agreed?"

"It sounds reasonable," I said, grudgingly.

"All right, let's work from there, a bit sketchily, to get the idea. Antarctica is—as nearly as we can tell from all data so far gathered—a vast respiratory system. Cold winds travel north across the sea. Hot winds travel south from the Equator, above the cold winds. So the elements breathe. Of course, both northerly and southerly winds are subject to changes, unpredictable current reversals. Right here the wind may be blowing due west. Two miles south it may be blowing due east. But in general, the 'breathing' is about as I've

stated. Will you accept that as a premise?"

"What else can I do?"

"Good! Then you'll have to go further and agree that it's possible, even highly probable, that the seasons—whatever they may be and whatever their variations from year to year—are born down here in Antarctica?"

Here I thought I caught a glimpse of something I could hang onto. I held up my hand for attention, halting his talk.

"My guess, then," I said, "is that Antarctica controls, if it controls anything, only the Southern Hemisphere. If you're interested in the seasons—as I'm beginning to suspect—why didn't we go to the Arctic instead of coming here?"

"You're catching on fast!" Geddes looked pleased. "My answer is simple. Antarctica is the unknown. Here there is no possibility of molestation or interference. Moreover, if I find out and am able to do the things I wish to do, it's better, I think, to influence only the Southern Hemisphere. When I've worked things out, then the whole world will agree and place all its power at my disposal, if I wish to go to the other extreme. So, I'm here simply and solely to avoid any interference with my work."

"But what *is* your work?"

"A complete scientific investigation of Antarctica! I plan to make two maps of it, one a regular chart—a geodetic survey—the other a mosaic. The mosaic will be first, because it is the easier to make. Then the chart will be made from the mosaic. I shall give the first complete map of Antarctica to the world."

I LET my breath out audibly. At least this didn't sound mad, if he had some way he could do it. "How?" I asked.

"One question," he grinned, "composed of one word. Yet to answer it adequately would use up words enough to fill volumes of books. I'm going to send out my mechanical men to photograph every inch of Antarctica."

"And they'll bring back photographs," I said, "which you'll put together here?"

"No, they'll *transmit* them, exactly as photographed, and at the exact instant photographed. You can see that they will keep Zora and me busy, and you, too, if you fit yourself to help us with our work. You'll have to do that, you know, to be able to report it in detail. We'll do other things at the same time. Meteorology for instance. The robots will take care of that for us. They are equipped to do it. We can keep a record of the weather in all its phases, coincident with our mosaic and our photography!"

It was beginning to get confused again. Just how much science *was* contained in each of those robots?

"I suppose those gentlemen of yours can go fishing, too? They can catch seals, birds, plumb the depths under the ice for any life that may be found there or in——"

"Oh, of course. That's coincidental with the chart we'll make of the ocean floor surrounding Antarctica! Biology, zoölogy, paleontology, ethnology—if any—anything and everything that science has found out about places in the world already explored or being explored. We shall know, when the job is finished, as much about Antarctica as we know about Fifth Avenue."

"The whole thing is beginning to scare me a little," I said, "not for what you plan to do, but for all the avenues of possibility that your work suggests."

"Such as what?" asked Geddes, leaning forward, suddenly very grave. Zora, too, leaned forward. For the first time those two mentally mighty people were interested in *my* thoughts as opposed to their own.

"Such as the possibility of *control* and——"

I stopped there, suddenly self-conscious. They kept on staring. They didn't even breathe, so steadily did they wait for me to go on. I was conscious, weird as it was, that even the robots working about the place had stopped, too, as though they also wished to listen. Maybe they did. Maybe they could.

"If some power were developed," I went on finally, "whereby the seasons could be controlled—whereby floods could be forecast and then averted—whereby drought could be foreseen and rain brought in its place—whereby earthquakes could be anticipated and prevented——"

Geddes leaned back. He and Zora exchanged excited glances.

"Eureka!" Geddes grinned. "That's the final proof. Draper has the layman's viewpoint, perhaps slightly more than the layman's imagination. If with *that* little nudging he can envision the rest——"

"Then you're right if only——" began Zora.

"Maybe I'm completely nuts," I interrupted, "maybe I'm wilder than a March hare, but suppose it were possible to control the polar winds? Suppose it were possible to even melt or partially melt the polar ice cap? Suppose it were possible to melt the bergs broken off at intervals? After all, that's what happens to them, isn't it? They drift into warm water and disappear——"

. THAT sort of stunned me. My own words calmed me down. Hell's bells, on the way here we'd seen bergs three hundred feet high, fifteen miles wide and thirty miles long. And I'd heard somewhere that seven-eighths of an iceberg was submerged. To think of such monsters being deliberately melted staggered my imagination. I began to flounder——

"Of course, if sunlight could somehow be directed, and concentrated on the largest iceberg fields, as their tops were melted they'd keep rising and melting completely——"

Geddes chuckled. "That, Jud, is the general idea. And it isn't impossible, with tireless workers. But have you thought of what such power—if we are able to develop and harness it—would mean to the Southern Hemisphere?"

I couldn't even hazard a guess.

"Nor can I—with any degree of accuracy," said Geddes, all at once subdued. "Nature has worked out her own balance. I believe—and science believes—that seasons born here effect only the Southern Hemisphere. But if we changed the lower half of the world a little, or a great deal, wouldn't the Equator shift—I mean the Equator of Seasons—and the entire Earth be affected? I don't know—but I believe so."

My imagination began to run riot. Just suppose that by the use of energy captured from the sun the bergs that now clung to the Shelf could be dispersed, erased. Suppose, further, that the Shelf itself could be gradually conquered, the continent uncovered right down to the soil, to the rocky backbone? It wasn't possible, but it could be imagined.

I stopped right there.

Geddes and his sister might have all this planned out, might even be sure that they could do at least a small percentage of what they planned doing. I didn't know. The world as we all knew it had had an Ice Age, and the great glaciers of that time had withdrawn to the north and south. Nature had done that. Could man, just one man—possessed of all modern scientific knowledge—bring it about scientifically, deliberately?

However, it wasn't just that that tickled my imagination, set it working overtime, but this: what would happen to Antarctica? What would it look like without its icecap? Had it ever known humanity, back in the dim and distant past? What had that humanity left of

itself, somewhere under the ice? Our own receding ice had left amazing records; why not this potential glacial recession?

In other words, if Geddes and his sister could do even one-tenth of what they were suggesting—*what would they release from the hitherto impregnable fortresses of the ancient ice?*

GEDDES and Zora were talking while I pondered this brain-staggering abstraction. I hadn't been listening. I butted right into their talk. "I wonder," I said softly, "what might be released in Antarctica—perhaps upon the world—if the glacial encasement could be removed?"

Zora gasped. Geddes, his face a study in strain, turned and looked at me. For a moment you could have heard a pin drop in the place—not that you couldn't, in periods of blizzardless cold, have heard a pin drop anyhow, anywhere in the laboratory—while brother and sister looked at me.

Then Geddes licked his lips and said in a low voice: "I've thought of everything, I think, except that. There can't be anything dangerous, of course. I've told myself that a thousand times. Zora and I have canvassed every possibility. The fact remains that whole continents have disappeared into the oceans, peopled by whole races of men. They've simply vanished. There's no way of knowing how far they progressed scientifically before they disappeared, for they've left no record—unless we find such records here—but the possibility always exists that we aren't within thousands of years of their civilizations. They may even have known the secret of life——"

It wasn't the Antarctic cold that chilled me, but his words. My mind flashed back to the ghastly days when we were unloading supplies on the shelf, and a vast area had broken off, just beyond the bow of our boat—and I had seen three majestic Emperor penguins imprisoned in the wall of green ice exposed by the calving. They looked alive. They may have been—must certainly have been—ice-locked there for centuries.

"Those Emperor penguins——" I muttered.

"Nonsense!" Geddes exploded. "Utter nonsense! There can be no possible connection."

"Then why were you practically reading my thoughts?" I demanded.

He closed his lips tightly, glared at me as though suddenly afraid I would attack him or protest against his plans. Then he said: "I'm not turning aside for anything that may happen here," he said. "Only the possibility that what I am doing may bring catastrophe to the inhabited world can turn me aside. Get that through your head, Jud! Whatever happens, we're not turning back! And we begin the mosaic, and everything pertinent thereto, in the morning."

We clung to the "morning" and "evening" usage, despite the fact that we were living in a night that was half a year long.

I rose, headed for the radio room.

"What are you going to do?" asked Geddes.

"Give the readers of my newspapers a chance to think we're all a lot of blasted fools! Meaning, of course, that I came and I stay—not that I could go very far on my own, at that."

I was sending out my first story from Antarctica when Zora came into the radio room. Quite calmly she put her arm across my shoulders. I looked up.

"Please like me, Jud," she said. "Deep down inside I have a feeling that one of these days I'm going to lean most heavily on your liking for me."

Her woman's intuition almost sent me to Geddes with a plea to give up the whole business. But because her intuition was such that she read my thought, she pushed me back into my chair and said: "Say nothing to Sherm. Don't for-

get that he has made up his mind, and that neither of us could sway him. For myself, I don't wish to. But you——"

"I can handle him—physically, if need be," I groused.

"Don't forget," she said softly, "that he has thirty *alter egos!*"

III.

SHERMAN GEDDES was ready to begin his work. He took two of his mechanical men, Numbers Eight and Nine, and gave them tasks I didn't believe it possible that they could do. One was to make the mosaic, the other the map, each according to a definite scale. The mosaic would look like an airplane-photographic map; the chart like a geodetic survey map. And what amazed me more than anything was that Geddes put Mr. Eight down at a table, as though he had actually been one of Geddes' fellow scientists, and carefully explained to him just what he wished done. He did the same with Mr. Nine, in front of a table whereon the chart was to be made. This chart was to be no system of sketches, fitted into a complete map by pantograph, but a chart done by inspection from the photographs transmitted—I didn't know how at first—from other mechanical men sent into the wastes. Mr. Nine, besides making the map from the photographs, must constantly check his accuracy with Mr. Eight's mosaic. The two therefore worked simultaneously, hand in hand.

"You will both watch the wall panel," said Geddes.

"It's absurd!" I ejaculated. "Talking to metal—they are metal, aren't they?—men as though they were human beings, with senses capable of picking up your speech and acting on it."

Geddes snapped at me. "Ask them!"

I stepped to Mr. Eight. "Repeat Mr. Geddes' instructions." Instantly, in no voice ever used by man, no voice man had ever recorded, the robot answered me. And as nearly as I could tell he was letter perfect. Word for word, he repeated Geddes' instructions. I still wasn't satisfied. I demanded the same thing of Number Nine, and he did just as well, in a voice that was entirely different from that of Eight, neither of which resembled the voice of Geddes. I flung up my hands. I believed it, as far as we had gone. But would my readers believe it?

I decided not to put them to the test until Geddes had got his outside work started. He selected his men—or rather took the first ones to hand, as there seemed to be no difference between them—and lined them up like soldiers awaiting inspection. He gave them instructions in their turn, to which Messrs. Eight and Nine appeared to listen with interest.

Numbers Thirteen and Twenty-seven were to remain at the laboratory to do the drudgery of the place, and to substitute for any of the others who might possibly break down—though Geddes said that this was extremely unlikely. Geddes gave each of his men a compass bearing, assuring them as he did so that it could be followed indefinitely without plunging them into the sea, though in an aside he told them to steer clear of breathing holes in the ice, and not to get caught in crevasses. The whole thing sounded absurd to me, but I listened spellbound just the same.

Geddes, Zora and I preceded the robots to the surface. It was a clear, cold night full of eerie whispers—the whispers of the ice in eternal growth and movement. Our own shadows before an orange moon were monstrous and grotesque beyond us. Mighty monoliths of upended ice cast shadows that were broad—somehow terrible—seeming to reach to the rim of the world.

For the first time, as each robot took his place at the starting point and without further instruction headed along the imaginary line which was his compass, I

noticed that their bright eyes had a reason for being. For light from them speared ahead for several hundred yards, bringing everything within its radius into sharp relief. One could have read newspapers a hundred yards away by those lights.

Geddes said: "Very well, gentlemen. Proceed along your courses until you receive further orders!"

THEY STARTED off smartly. They looked for all the world like men with headlights, if one could conceive of such a thing. I missed the vapor of their breath—a little thing that made them seem weird. But aside from that they were simply twenty-six men, marching into the Antarctic night without food, water, or sleeping bags. They could—and would unless told differently—go on indefinitely.

The play of their lights off ahead of them splashed the surface of Antarctica with millions of eyes. The display was dazzling while the robots were reasonably close together, but blended oddly—broke off slowly—as the members of that partial wheel, of which they were the spokes, rolled away from us.

"We've got to get back," said Sherman, "to make sure we miss none of it."

We darted back into the laboratory to find Eight and Nine extremely busy, working faster and with far greater precision than any two human beings could have worked. They glanced at the wall panel, then at their work. Their hands, as facile as mine—or more so—then got busy with topographic instruments. I knew without looking that they were doing their work with all the exactness required by science—which would be exact indeed, to suit Sherm Geddes.

The work of Eight and Nine was fascinating, but what really got me going and fascinated me to the point of making me forget all about radios to the States, all about eating, sleeping—almost about breathing—was what I saw on the wall panels.

Now I understood—at least as far as the purpose went—the white squares that made the wall panel look like a checkerboard. Under each was a number. That number corresponded with one of the robots who marched this very minute along one of twenty-six compass bearings, into the deeper heart of Antarctica —*and what his glaring eyes saw in the wastes, all of us there in the laboratory saw in the white square above that robot's number.* If, for instance, I wished to see what the eyes of Mr. Twenty were seeing at that identical moment, all I had to do was look at the white square on the wall panel above the figure twenty. It seemed almost as though I were walking in the place of Mr. Twenty.

Eight and Nine were seeing those pictures, transmuting them into a mosaic and a chart.

Immediately I wondered if Sherman Geddes had thought to equip his robots with memory. I turned and asked him.

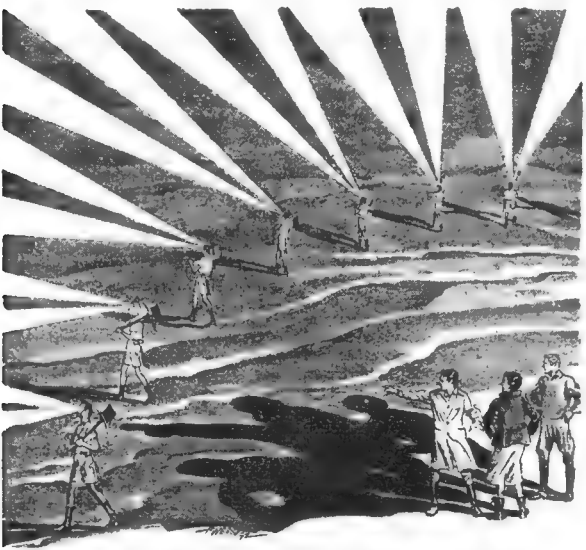
"Of course," he said. "Indelible records are made—within the brain of each robot—of everything he sees. When they come back we can further check our work by checking the brain of the robot whose photographic eyes saw those things. All we have to do is seat him and tell him to repeat his findings for us —and there it will be, on the square above his number!"

My breath went out of me as though I had been a collapsing toy balloon. I sat and stared. Geddes and Zora were checking the work of Eight and Nine, against their own observations of the wall panel. I knew I'd be useless here, for those two robots had to see and record the work, simultaneously, of twenty-six men. Right at that moment I regarded the thirty *alter egos* of Sherman Geddes as men. I still so regard them, and it doesn't seem strange. It only seems—and then seemed—strange that nobody who made robots had ever

done what should have seemed the simplest thing: made man in all his perfection, with none of his imperfections. Nature developed and tested man's structure and tools—hands—over millions of years, and made them efficient. I suppose I might have asked Geddes for information as to the construction of his men, but I didn't. I didn't even ask him of what metal they were constructed—though it must have been of some weatherproof composition of his own invention. It had to be.

I simply sat and watched—first one and then the other, of those squares on the wall panel—and marveled at the widths and depths of them. The robots on their march played their lights constantly from right to left. They moved rather slowly, as though accustoming themselves to their work, and what their "eyes" saw, I saw. I had but to pick out the sights which intrigued me most and watch them, spellbound. But whenever I stared at one square more than a minute or two, I discovered that even more amazing things were being shown on one of the others.

GEDDES came to me after a bit, laughing. His laughter expressed his scientific triumph so far. "It's a lot worse than watching a five-ring circus, isn't it, Jud? But never mind. If you



I missed the vapor of breath—but these machines could go on indefinitely into Antarctica's unknown heart——

wish, when they are brought in I'll have each one show his stuff all over again so that you can see everything you are bound to miss now. My topographers, you see, are far enough back from the panel that they can see all squares simultaneously, which neither Zora nor I can do. And *their* eyes record the minutest details, exactly as do the eyes of their comrades out in the wastes. They couldn't make mistakes if they wanted to —and they couldn't want to without my permission!"

The black squares in the panels had their uses, too. They were studded with infinitely small meters. Geddes told me that in addition to the photographs, each robot sent back the wind velocity and its direction, which those little meters recorded. Also the depths of the ice with every step taken. The temperature and barometric reading followed as a matter of course. I heard Geddes tell Eight and Nine to record those figures on the mosaic and the chart, together with the date and hour of their registration.

"But why, if they can go out and get such data, and 'remember' it," I said, "don't you just send them out and wait until you want to bring them back?"

"I couldn't bear to wait," said Geddes simply. "I've waited five years as it is. Besides, it will save all sorts of time. And you can send it out piecemeal to your readers."

I forgot Geddes and Zora next minute. I was watching the course of Mr. Seventeen, which was, roughly, southwest. I saw, first, the almost level—save for the zastrugi—expanse of the waste which all of us had seen from the surface, before the sun had disappeared. I saw the limits which our own eyes, then, had prescribed. But I saw limits beyond those limits begin to crawl into the glaring eyes of Mr. Seventeen. The way became more tumbled. I saw crevasses come into Mr. Seventeen's lights, move inexorably to trap his mechanical feet. I saw the crevasses vanish under his feet. There was a swift forward movement, a jiggling of the light, and I knew that Mr. Seventeen had jumped the crevasse.

I whirled to white square number seventeen. The crevasse he had just jumped was reported as being four hundred feet deep and thirteen feet across at the top. I whirled, raced to the mosaic and the map. Eight and Nine had recorded the figures just shot to us by Mr. Seventeen. I went back to watching that gentleman, satisfied at last that the record was straight. I sort of wished he had shown us the crevasse by looking into it, but he didn't. I hadn't been away for more than a minute, but when I again saw with the eyes of Mr. Seventeen he had entered a region where the world stood on end. Great spires, hummocks, pillars and monoliths of ice reared up at the sky. How much of them was just ice I could not tell then, or whether the ice sheathed spires, hummocks, pillars and monoliths of stone. I was too interested in traveling with Mr. Seventeen through the nightmare place.

His eyes caused the shapes of the ice to glisten as with millions of tiny crystals. The place through which he moved was a fairyland beyond any fairyland ever described by the tale-tellers. There were ways through the ice shapes that were narrow, appallingly lovely, and he took to them unerringly. Geddes had made no mechanical mistakes with Mr. Seventeen, and that gentleman wasted no time bumping himself against impassable obstacles, or in trying to go over them. He threaded his way through as no human being could——

"And he hasn't the slightest sense of fear of the unknown!" said Zora softly, at my side. I didn't even look at her. But she had read my mind I suppose. For, traveling with Mr. Seventeen, I got gooseflesh all over me, expecting I hadn't the slightest idea what, to come out from among those eerie shapes to the attack. Mr. Seventeen had no such

nervous drawbacks. He followed, roughly when he had to, exactly when he could, the compass bearing given him by Geddes. And with his eyes I saw the shimmering light, far to his right, of the eyes of Mr. Twelve, and to his left the eyes of Mr. Sixteen. Where his lights collided with either, were the points at which Mr. Eight and Mr. Nine "tied in" the elements of their mosaic and their map. It was, frankly, thrilling stuff to watch. Planning to take a walk, later, with one of the others, I stuck to Mr. Seventeen for the time being. I didn't care if the icy minarets, with all their reflected beauty, all their monstrous shadows beyond the lights, never came to an end at all. It was music made visible, and I was drinking it in, and feeling as though I were somehow sharing the glories of Creation with the maker responsible for it. It gave me such a lift as I had never dreamed possible to a human being. If I breathed at all I was not conscious of it.

NOW AND AGAIN I heard exclamations from Sherman Geddes. The man was beside himself with delight. In a matter of minutes he was getting information that men had died to get—and failed. He was doing in minutes what would have taken human beings days and weeks of arduous toil to accomplish. I didn't blame him for his pride and enthusiasm. I was sharing in it, and my spirits were soaring.

Mr. Seventeen. Playing his light about, giving Eight and Nine every opportunity to pick up every slightest declivity, every rise of ice or ice-incrusted land, he forged steadily forward. I knew that when the robots got too far apart there would be blank spaces on both mosaic and map, and wondered what Geddes intended doing about those. But he'd work that out somehow, I was sure. It was, really, a minor detail. With such tireless workers he could bring them back at any time, giving them new bearings that would fill in the vacant places.

But Seventeen——

After what seemed like split seconds —yet must have been fully an hour—he passed through the upended field of ice —and whatever it may have masked—and entered a narrow valley. I thought the minarets and hummocks were beautiful, but this was even more so. This valley was narrow, with walls fully two hundred feet high to right and left. I judged the rims to be perhaps an eighth of a mile apart on the average.

Dug out by a slow-moving glacier, down the ages? If so, why didn't it fill up? The site of an ancient watercourse? If so, which way did it run. No, I didn't ask myself any of these questions; I simply watched and tried to see it all. Seventeen walked right along the center of that valley. I wondered—irrelevantly —what his shadow was like behind him. But there was no way of knowing and I dismissed the thought instantly. Those walls—precipices—were almost sheer. They glistened like crusted snow in bright moonlight. They glared with a million-million eyes at the two miraculous eyes of Mr. Seventeen. The latter played his lights over those walls, showing their winding and twisting, showing all that the eye of a camera could have seen had there been one in the hands of Seventeen.

There wasn't, of course. His eyes were the cameras. Strangely, while he was traveling southwest, I saw what he saw by looking almost due north. But it wasn't until I began to check up on things that I noticed this. Nor did it disconcert or confuse me. I thought of the masterly technical work of Sherman Geddes and Zora, and realized that I didn't really hate Zora, after all. She had proved her right to any feeling of superiority she may have felt merely by being worthy of being Sherman's assistant.

I held fast to Seventeen until he

passed clear through that valley. It took him four hours, though I didn't know that until he was through and I looked at my watch. And ever and anon, as he traveled, I saw the twin beams of the lights of the robot to his left, and the beams of the robot to his right.

Then, swiftly, he was out of the valley—which broke away to right and left to give way to a plain so vast that there was no seeing the limits of it. A former lake-bed, into which an ancient river had drained? Or a lake-bed from which a former river had flown? I wouldn't know until I looked at the records and ascertained whether Seventeen's way led up or down. Even then what would I know? Nothing. Geddes would know, I thought, and if he saw fit to tell me——

That valley might have been excavated by human hands—but if so, where were those hands now, and what kept the valley open in spite of centuries of blizzards which should have filled it brimful of drift? Maybe the vast plain into which Seventeen was going had been farmland, the site of a monster city. Oh, it was easy for the imagination to picture all sorts of possibilities.

Seventeen looked to the left, and in the glare of his lights I saw five other robots, each on his proper course—the five of them giving me a slight inkling of the vastness of that plain. There were three more to Seventeen's right. Nine robots in sight—not that exactly, since we couldn't see Seventeen—traveling different courses, yet all entering that vast plain. And beyond their lights—as I looked at the square of each swiftly—the plain stretched away to a limitless expanse. At least far beyond the scope of their lights, or eyes.

THEY KEPT steadily on their courses. Now and again I saw with the eyes of the robot on the extreme right, trying to pick up robots still farther to his right. I did the same to the left, but there were only nine within that particular compass. Others were still busy with their work. But I didn't check on them just yet. The nine interested me more, so I stuck to them, watching them usually through the eyes of Mr. Seventeen. I glued my eyes to the outermost limits of his lights, and waited for something—I couldn't even imagine what—to come out of the immensity ahead of him and take form. There were a few crevasses, a few hummocks, but aside from those—just that vast plain.

And after a bit, with each step taken by Seventeen, a nameless terror began to grow in me. I felt the terror of the unknown as I had never believed it possible for me to feel it. The blackness was a tangible thing waiting to engulf me—in the person of Seventeen, and with him all of his eight comrades. And all nine of them, by this time, had become my comrades, too. If anything happened to any or all of them, the loss, now, would be personal and tremendous. Through their eyes Geddes, Zora and I were seeing things no human being in the known history of the world had ever seen.

And when Geddes, as he sometimes did, stepped to this square or that and pressed a button, we heard sounds that came from the spots where the robots walked—sounds that might have been heard first at the dawn of Creation.

"I could bring sound into the laboratory from each and every one, singly or all together," said Geddes softly, "but the combined roaring would deafen us all."

He was probably right, for the sound that burst in the laboratory when we listened only with the "ears" of Seventeen was cataclysmic. Roaring wind like nothing I had ever heard smashed about Seventeen. It crackled, screamed, shrieked. It sounded like thousands of tons of shelf ice letting go, dropping into the sea. It sounded like a score of Niagaras running wild. It sounded like

nothing I had ever learned the words to describe. It was Nature in all her immensity, giving birth—to what? The fact that I didn't know was what filled me with that growing terror——

Beside me Zora was breathing audibly. I glanced at her. Her eyes were wide. Her bosom was heaving. She couldn't be afraid of what might happen to the robots, surely, for there were extras we hadn't yet unpacked, and they were merely pieces of machinery, after all. No, it wasn't that, I thought, and a moment later I knew I had been right. For Zora whirled on her brother and screamed: "Bring them back, Sherm! Bring them back, for my sake. I can't stand it any longer! I'm terribly afraid that——"

"Afraid?" said Geddes softly. "Of what? Nothing that might possibly trouble our robots can reach us here!"

"I'm afraid of—— Please, Sherman, let's call a halt. You can stop them, leave them right where they are! Do it for me. Let their eyes die, so that they can hide from——"

"Hide from what?" yelled Geddes. "Zora, you're nuts! What can there possibly be to hide from? Rocks? Hills? Glaciers? Crevasses? I've never known you to be so childish, so imaginative."

"I ought to be ashamed of myself, Sherm, I know. But I can't help it. The feeling keeps growing on me that soon in those white squares—at least of the nine robots in the plain, maybe even in all the others—we're going to see things that may be so tremendous—so maddening——"

"Nothing in this world can drive *you* mad," said Geddes. "You're my sister!"

"Jud! Jud!" said Zora, flinging herself into my arms. "Say something to him! You feel it, too; I can see it in your eyes—in the sweat on your cheeks and in your hair. Ask him to delay his investigations, even for an hour."

"I agree with her, Sherm," I said. "Let's call a halt for a little while."

"Nothing doing!" In his two words of refusal there was finality that I couldn't gainsay. Well, there might be some other way.

I put Zora aside, rose, stepped toward Sherman Geddes. "Sherman," I said, "stop it, right now. Give the command, or so help me——"

"Sit down, Mr. Draper," said a cold voice to my right rear, "or it will be my duty to force you to!"

I whirled, stared. Standing within two feet of me, radiating power against which I knew I'd be less than a babe in arms, was Mr. Thirteen.

IV.

WHAT USE could there be for me to fight Mr. Thirteen? It was idiotic on the face of it. And futile. I hadn't a chance, and if I had, what then? There still were three robots in the place. I sat down again. Zora was softly weeping, and something inside me turned over. I hated to hear her crying. Superior she may have been, in ordinary circumstances, but in a situation like this she had to lean on some one like any ordinary woman. The fact that she selected me caused all my inhibitions to roll away.

I patted her shoulder: "All we can do is wait and see what develops," I said.

"There's something coming to us," she sobbed. "I can feel it. It's there, in that plain——"

"And that isn't intuition, either," said Geddes excitedly. "You've more than suspicion to back up what you're saying, Zora! There *is* something queer about that place. If you'll look closely you'll see how symmetrical the walls of it are, and how they make you think *of the walls of a mighty fortress!* Those walls, my friends, mean something to me. If, as I suspect, they once held back the encroachment of the ice, they can now hold

back whatever power I may unleash within them. I'm going to find out what lies under the ice there—as soon as we have established the limits of the plain, or amphitheater floor."

I got a chill at his words. Could it be possible that yet other miracles, beyond even the range of human imagination, were possible to those lifelike robots of Geddes'? Just what did he mean? I'd talked of controlling the elements; could Geddes somehow do it? Was the secret of his plans contained in the mechanism of those robots not yet brought into play?

While we were waiting to find out, those nine robots marched across that plain, still keeping to their compass bearings and so gradually drawing farther apart. I looked at the squares of each of them, one after the other, as eager to discover the limits of that queer plain as Geddes could possibly be. And the conviction was growing in me that something amazing beyond words was hidden under the ice. Winds howled when we brought in sound from any of the nine robots—yet there was no drift in the plain under those mighty walls. That meant—Geddes explained—that the winds were somehow diverted over it, did not dip down into it. The ice, therefore, was probably the slow accretion of the ages, born of occasional high temperatures and thawing water that had run into the place. If the main portion of the Great Barrier—of all Antarctica—increased in height a mere foot in a year, how long had that ice been forming on the plain, at what must have been far less "growth"?

The robots continued their strange, eerie march. Now and again Geddes cut in sound from one or the other of them, and it was becoming more and more something we had never heard before, something we had not experienced.

Two hours, on the average, the robots marched across that plain. Now two additional robots had entered the place, which gave me some idea of its vastness, since by now the robots were miles apart. And then the three who had been first to enter the vast amphitheater came up suddenly against a wall that towered into the sky fully two thousand feet.

"The backbone of the continent!" said Geddes scarcely above a whisper. "They can't go any farther on their current orders."

The three robots had indeed come to a stop. They were standing at the base of that sheer precipice, playing their lights over its face. They did not move to right or left, save as their lights moved—showing them nothing but the sheer wall. And one by one the other eight robots came to the same dead end, beyond which there was no advance. Finally they merely stood, with their lights on the wall, waiting for orders to continue, or to circle the wall.

"I'm going to send the others into the plain, all of them!" said Geddes excitedly.

"No, Sherm, no!" said Zora. But he was beyond hearing her. He was on the heels, he thought, of some great discovery, and nothing could keep him from going ahead. I felt as Zora did, but over anr beyond my feeling was a vast curiosity which made me sympathize with whatever fanaticism was burning in the breast of Sherman Geddes. I wanted to see, as he did; but I was afraid and he wasn't. He was only impatient.

HE WORKED with the apparatus that controlled the robots not yet on that plan, which was now more a valley than a plain, more a vast amphitheater than either. One by one the robots reached the walls, and by devious ways found their way into the place.

Now Geddes explained to me: "In order," he said, "that you may let the world know exactly what we are doing!"

During all the time this had been going on there had been signals from the radio room which I had ignored. I had

been expecting those calls. For who could possibly believe the stuff I had sent out, about mechanical men who could not be told from living men? About men with headlights for eyes? Cameras for eyes? Cameras which were radio-controlled? Geddes had simply expanded the possibilities of the radio-photograph to his own ends. Details scarcely mattered. Few people, anyhow, knew any more about radio itself than that if you turned a certain dial you brought in a certain crooner. They were satisfied with that. If anything went wrong with their sets they called in miracle-workers to put them right.

Geddes now called me to him. The four robots in the laboratory paid us no heed, save that Eight and Nine went on mechanically with their work, recording over and over again the far walls of that vast amphitheater—in which, now, all twenty-six robots were standing, against that far wall. It was a good thing for them, I thought with a shudder, that they *did* have no fear of the unknown.

"It's time you knew a little more about the robots, Jud," said Geddes. "Their eyes, you know, are a species of rays, as are lights from ordinary automobile headlights. But they are transmutable to other——"

"Transmutable? I don't get it. Make it easy."

"I figured, when those eyes were made, that all of the various rays known to man, and used by him—whether in the street or in the most intelligently scientific library—could be utilized through the selfsame orifices. Military experts have certain death-rays. Marconi, Tesla and others, have discovered various other rays. I have made use of them all—together with several of my own discovery—which you will tell the world about for the first time——"

"Including the Roentgen Ray?" I asked.

"Of course. Also the Geddes Ray, my own——" He hesitated. He was in the grip of a tremendous emotion, that was plain. His breath came and went heavily, as though he were dragging a great burden. But his eyes were alight with the scientist's vision of discovery. "With the Geddes Ray," he went on, "I don't have to clear the ice on the floor of that plain to see what's under it. I can range the robots in a vast circle about any given point, and have them send the Geddes Rays down at any angle, and show us what the ice covers! I can also send any or all the rays from those same eye-sockets simultaneously. So, when the Geddes Rays show us what is under the ice, the light rays will make whatever it is visible——"

"On second thought," continued Geddes, "I'll simply have the robots face about and come this way, showing us step by step what lies under the ice there——"

He dashed to the controls on the table, to the gadgets under the squares on the wall panel. He moved with the speed of a man possessed. I watched Mr. Seventeen, and with him I faced directly about. The sensation of so facing was so real that I felt as though I myself had performed an about-face. The robots were now all faced back along the bearings they had followed away from our camp.

"I now turn the light rays downward at an angle of sixty degrees," said Geddes softly. "There, you see? Now all we see in the white squares is the face of the amphitheater's floor. Watch closely, for when the Geddes Rays are sent forth, along the light rays, we shall see what lies under the ice, so!"

EVEN GEDDES himself was snatched into awestruck silence at what those white squares now disclosed. We looked down through ice as though through clear cool water, to an amazing depth—a thousand to fifteen hundred feet at least. And I could not forbear a gasp of stunned amazement. For we

were looking slantwise at the walls of a city! There could be no mistake. Towers of amazing beauty reached up toward the surface of the ice. There were cathedrals never seen, by any one since the dawn of history on the face of this Earth. There was a system of streets lacking all the ugliness we know in our modern world. There were churches of some kind, recognizable because there was about them, even as we saw them, something awe-inspiring that was not born of just the Earth. There were fountains; there were parks —plazas.

The robots began to march, unreeling for us the beauties of that vast city, drowned for no one knew how many centuries under the ice. Mighty buildings which were beautiful beyond words, from their bases to their needle-sharp spires. Winding pathways. And there were trees in the parks, along the avenues, stately as the day the ice had taken them and frozen them solid. I didn't know the trees, had never seen their like before. But the lights from our robots showed us orange, blue, indigo—all the colors of the rainbow, in the leaves of those gorgeous trees. Geddes himself could name not one of them, for I asked him.

I didn't believe my eyes, but when I looked at Zora, and at Geddes, I knew that each saw the things I did, and were lost in the strange glory of the discovery.

The robots marched until they came to the near limits of the city. There, at command, they halted. Geddes looked at Zora and me. The same thought was in the mind of each: that city had been deserted. We all knew why. Its inhabitants had been warned, and had fled. But if they had not fled, and knew that doom was approaching, where would they have faced it? In their places of worship! In their homes!

"Now," said Geddes softly, "we'll look into the houses."

Zora did not protest. Those silent, drowned buildings had gripped her imagination. She could feel the silence in which that city had been locked since before the dawn of creation as we had it in our modern traditions. She had to know, as we had to know.

The robots faced about once more, began the march back, their lights turned down, but now lights from which traveled the unknown rays that Geddes had named for me. And we could look through the walls of those houses as though they did not exist. And they were stone walls, too, of stone taken from the surrounding mountains. When the first view of an interior broke on one of the white squares, all three of us gathered about it.

I can't explain my feelings. I'll merely try to describe what I saw. A family group. Men, women, children, standing quietly in the middle of a floor of beautiful mosaic pattern, with their faces uplifted. Those faces were yellow, as though with great age, but all of them were handsome or lovely. The men were handsome, the women lovely, the children like dolls with lemon skins. Their upturned faces made me think that destruction had come to them from above, and that they had met it unafraid. A woman had a baby in her arms. A young man and a young girl—sweethearts perhaps—held hands.

Their clothing was of the brightest, richest coloring imaginable. It resembled none I had ever seen, except insofar as it fitted the bodies of the wearers and so was shaped to those bodies—which were undeniably human.

On to the next building. Geddes was panting like a spent runner. His eyes did not blink, for I watched him closely —unless they blinked when mine did.

"By careful estimate," said Geddes—when the robots had marched again across the roof of the city, as though they walked on water—"there were half a million people in that city when the ice got them. Note how they are all stand-

ing. Not in twisted attitudes at all; they were taken suddenly, so suddenly that they were caught just as they stood. Jud?"

"Yes?"

"Suppose they knew it was coming, that the end was inevitable. They obviously had warning. Maybe they had warning a year, ten years in advance of catastrophe. My guess is that they knew centuries in advance—else they would not have built their city behind the ramparts of those mighty walls. Very well, we know they were intelligent, as intelligent and progressive as any civilization of to-day—perhaps were even far in advance. If this is so—and it must be, if you'll keep remembering the lovely symmetry of their city—then their scientists must have been far in advance of ours. Must have known all we know to-day, and more. Jud, I'm supposed to be the best scientist alive to-day. I *am* the best; this is no time for false modesty. Yet I know that when that city died, scientists beside whom I would be a nursing child were buried with it. And they were warned—had time to prepare——"

"SHERM!" gasped Zora, who began to get what he was driving at long before I did—how could I possibly imagine what was in Geddes' mind?—and was looking ahead. "You can't possibly mean——"

"But I *do* mean that it isn't beyond the bounds of possibility—as far as we know to-day, though we haven't accomplished anything even remotely resembling the miracle I have in mind—that some or all of those people *may be alive!*"

I laughed, but even to me my voice sounded hollow.

Take catalepsy," said Geddes inexorably, "in the throes of which—before embalming came into popular use—men, women and children were buried alive. Take hypnotism, wherein subjects approach the phenomenon of death, yet are not dead. Can life be preserved in the ice? We haven't been able to so preserve it. Yet the way has been indicated thousands of times——"

"How?" I demanded.

"Mammoths caught in the ice—dug up thousands of years later—their meat edible——"

"But the mammoths dead!" I interrupted.

"If the material substance of life can be preserved," said Geddes, "why not life itself? Whence does it come? Where is the living thing suspended before it is born? Whence comes the soul? Where does life go when the material part of human mechanism ceases to be—decomposes—returns to the dust? We don't know. But what if *they* did?"

He pointed to a family group, on the white square under the number of Mr. Seventeen.

"Maybe they're all dead," resumed Geddes. "I intend to find out. If they are, we've still written a great page in history. If there is life in them, after we have reached them——"

Zora said, "If Nature did that to them, there was a purpose behind it. It isn't up to you to thwart powers of which you know nothing. You are not God, Sherman Geddes!"

"What has that remark to do with science?" said Geddes.

"As a scientist," said Zora, even more softly, "you have proven over and over again the existence of Infinite Intelligence—and you know it better than any one else alive to-day!" Think, before you do this thing!"

"I have thought," said Geddes, "and I shall explore that city, walk its streets, examine its people—alive or dead! It will be a simple thing for the robots. They will simply disintegrate the ice, evaporating instantly the water that will be formed. When they stand on the city streets, those streets will be dry! That's as simply as I can put it, Jud. And those ramparts are made to order

for this experiment. Nothing that happens so deep in the heart of Antarctica can do any damage to any nation in the world——"

HE SET the robots working. A great white cloud rose over the plain and was snatched away by the winds even as it rose. The floor of the plain dropped swiftly as the energy from the robots played over it. Spires came through finally, like needles through clothing. I think all three of us held our breath as the buildings of that dream city came again into the light of day—or rather of the Antarctic night.

How long it took I was never afterward to know or remember. But finally the robots stood on the streets, like people from another planet dropped down from the skies. The streets were empty. Their lights played around, showing us more and more of the finest architecture the world—ever—could have seen.

We riveted our eyes on the doorways of those buildings, waiting—waiting——

Would anything living ever emerge?

"Twenty Four!" shrieked Geddes suddenly. "Twenty Four! Don't go into that building! Jud—Zora—there's something wrong! Twenty Four is entering that large building on the edge of the biggest park. I not only did not tell him to do anything of the sort—I forbade him, or any of the others—doing it——"

I whirled, looked at the square of Twenty Four.

It showed the side of a marble-walled building, and a door of metal that shone like a myriad of diamonds, set side by side. It couldn't be possible—yet the instant I saw that door, and recognized it as a door, it began to swing open—inward.

But—before ever I could see the interior of the building—the white square of Mr. Twenty Four *became white indeed—utterly blank!*

V.

"BUT SHERMAN," I gasped, "before the robots got down to the city streets, we could see into the houses!"

"I turned off the Geddes Rays," he said unevenly. "And now I can't turn them on again. Something has happened to the central control here. I can't understand it, it——"

"—has passed out of your hands, Sherm, and you might as well admit it," said Zora, her voice hollow.

There was the sound of crackling material behind us. All three of us whirled. Mr. Eight and Mr. Nine had folded the parchment on which they had been making the mosaic and the chart. They thrust them gently into their clothing. Thirteen and Twenty Seven were standing at the door that led out through a ramp to the surface.

"Come back here!" snapped Geddes, flinging himself at the nearest of the four robots. He reached out his hands to clutch at the robot—feeling, I suppose, that they were human after all. They were—*super*human. And Geddes touched Mr. Eight, whose hands moved with the speed of light. I didn't see the blow, exactly, to know that it was a blow. But I saw Geddes' body go hurtling through the air, halfway across the laboratory. His life was saved only because he crashed into a pile of clothing.

The four robots went out soundlessly. There was something ironical in the fact that they closed the door behind them. Nor did their going register anything—except sound—on the white squares under which their numbers were. Geddes tried to see with their eyes and the four squares remained blank. He could bring in the sound of the wind across the wastes, the sound of the robots' feet in the snow and ice. That was all, except for the crackling of shifting ice that never ceased in Antarctica.

The four simply went south into an

appalling nothingness, save for the sounds that registered.

We watched the other squares. They were now all blank, all empty of anything save sound. The sound we got from that amphitheater, however, was the buzzing sound a multitude of human beings would have made—the sound a multitude of human beings *was* making! Words—but none that we could understand. Sherman Geddes glued himself to the panel, trying to make out those words.

"It isn't Sanscrit," he said. "Or Phœnician, or Gothic or Latin. Yet now and again I catch words that suggest meaning. If there were only a philologist here with us. All I have discovered is that some of the words of some of to-day's languages—of which I have more than a smattering of fifteen—plainly derive from the words we are hearing here! Let that mean little or much. We haven't time to study it here and now——"

From the other end of the laboratory came suddenly an appalling sound. We all whirled and looked. Once what I now saw would have frightened me out of my wits. Now it was nothing compared to the feeling that somehow we had let catastrophe loose in Antarctica. What had happened was simply this: the box containing the other robots—Geddes had provided an extra of each of those now in that amphitheater, or en-route thereto—had exploded like a firecracker, and the other robots were coming forth into the laboratory.

I looked at Geddes. His eyes, and those of Zora, flashed to the wall panel and to the table.

"I didn't tell them to come out," said Geddes.

IN A MATTER of seconds it was plain that he spoke the truth. His control even of these had vanished somehow. Those thirty additional robots marched to the door, and out across the wastes, following on the heels of their predecessors almost at a dead run. Geddes' face now was pale as death.

"I never believed it possible that anybody in the world but Zora and I could control them. How has control been taken away from us?"

"Didn't you say," I said, "that there were scientists in that ice-locked city who, if they had managed to preserve themselves in the ice, would be, to you, as giants to a baby?"

"That's the answer!" he whispered. "That's the answer. It has to be——"

"But how can those people—gone these centuries, before there was ever such a language as English—understand anything about the robots?"

He almost snarled his answer. "Our explorers have no trouble deciphering hieroglyphics on pyramids in Africa and Yucatan, or in the Andes! If those ancient people were discovered in places now marked blank on the map, do you think we haven't people who could understand them? Then—if my supposition has any basis in fact—there are people in this city who can understand English the first time they hear it spoken! Step up the intelligence of present-day liguists, multiply their ability by ten—which may be an underestimation—and you may approximate the intelligence of the people who built that city into which we can no longer see. Jud, warn the world of everything! No telling what may happen now. I brought vast power into the Antarctic with me. Other brains now control that power. What use they may make of it——"

I dashed to my radio, which I had scarcely heeded for days. I began to talk with Rio de Janeiro. I'd set the world crazy with my articles, and I had told the world so little. Robots that were superhuman? Impossible! So said the outside world. Would the outside

world believe, then, when I went further and told them what had happened since I had given it a hint of the possibilities of Geddes' robots?

My whole body was bathed in sweat as I tried to tell Rio what had happened.

"We sent the robots south," I began, "and their eyes were the lenses of cameras more efficient than any others in existence. What the robots saw was transmitted back to us here at the base, by radio, and we saw what they saw, on the panels corresponding to the numbers which identified the robots——"

"Your message must be wrong!" shrieked Rio.

"Shut up, listen!" I retorted. "I'm telling the gospel truth. How long I may live to tell it, I don't know. But the world must be told, in the event that the world must prepare to avoid destruction——"

"Mad! Mad!" said Rio.

"Draper!" cut in New York. "What sort of a hoax are you trying on the world?"

"We discovered a vast city, under the ice," I went on. "Believe me or not, as you wish, but keep your apparatus open! Don't miss anything I tell you, no matter how wild it sounds. Geddes Rays showed us the city under the amphitheater——"

"Geddes Rays! Geddes Rays! What are they?" asked London.

"I haven't time to explain—except that with them Geddes was able to look through the ice that covered the city. Then—listen to me! Don't cut me off! You've got to believe me!"

I WENT ON, told the world everything to date that I have so far recorded in this chronicle. I was called a liar in a score of languages, but the world listened. Geddes was waiting for me when I had finished. I told the world to wait, but I stepped away from the radio to close my ears to the jeers of the world.

"Jud," said Geddes, "this may be far more serious than we could possibly have dreamed. Those robots—Eight and Nine—taking the mosaic and the chart. You know what I intended to do with them?"

"I can guess. Calculate to a nicety the force and direction of polar winds, temperature over all Antarctica—and then know exactly how to control those winds to effect the seasons of the Southern Hemisphere as you wished. To avoid too much heat here—too much rain there—and the opposite——"

"And those people have *that* power, too!" said Geddes grimly. "Or, rather, those powers. I intended to use my inventions—if given an opportunity, and they were feasible—for the betterment of nations. You must understand that those who now control our robots not only have no such compunctions, but probably know nothing at all of the outside world. Do you understand?"

I didn't. But I got my first inkling when I looked at the thermometer. The temperature outside the door of the laboratory had risen twenty degrees in a matter of hours—and was still rising. In a short time—if the temperature climb continued—ice would begin to melt. And this in the heart of the Antarctic night!

Terrified, Geddes as frightened now as either Zora or myself, we went back into the laboratory. Water was dripping through the roof of the place. Moisture oozed from the walls.

Then, came the rumbling shock of an earthquake.

I stared at Geddes. He stared back.

"Shelf ice," he said, "going out of the Bay of Whales, or out of Ross Sea! And at this time of the year, with the sun gone for weeks, it simply isn't possible unless——"

"Unless your robots have given up their innermost secrets to those who now command their allegiance!"

The laboratory began to rock. I felt a sudden nausea. Zora sat down, looking as though she were suffering from seasickness. But we soon accustomed ourselves to the rocking of the laboratory. We had to, for it did not cease—except for rare intervals—from that moment until the horror ended.

"They have the power," said Geddes quietly, "and they're using it. I wish I'd never started this thing. No, I don't, either. We've written new pages in history——"

"And *they* are about to tear up the whole book!" said Zora.

Geddes whirled on me. "Tell Rio, and London—New York——"

"But what happens here affects only the Southern Hemisphere!" I interrupted. "Perhaps even only the Pacific Quadrant! Why then, warn——"

"Listen, Jud," said Geddes, his lips dead white, "we don't really know for sure what part of the world can be affected, if any part of it. We can only theorize until we find proof. I can prove almost any statement that can be made, with theories which modern advanced science accepts without question. I can disprove, absolutely, those same theories, with other theories which modern advanced science also accepts without question. I can prove evolution. I can disprove it. All of which means that nobody, ever, can really *know* anything!"

I RACED BACK to the radio. Geddes went with me, telling me what to say. I repeated his words—after telling the world through its great radio stations to keep silent, and listen.

"Be prepared for a cataclysmic disruption of the seasons," said the cold, inexorable voice of Sherman Geddes. "The power I brought here, which is all the power known to the modern world of science—and multiplied by the knowledge of Sherman Geddes, shared only with his sister, because Geddes is an egotist who should be locked behind bars beyond all possibility of causing harm—has been taken from me, has fallen into alien hands. I don't know what they'll do with it——"

"You're claiming," cut in Rio, "that the dead in that hoax city you reported, have come to life?"

"They never were dead," said Geddes, while I repeated his words. "They simply stood still in time for centuries to a number I don't even dare guess at. And our power released them, started them going again—like clocks that are run down, then rewound——"

"This," said London quietly, "is quite mad."

Geddes cut in when I stepped aside to give him the chance, and he told the world who he was. I knew, when I listened to him, that his other listeners had to believe, too. They couldn't help believing when his calm words fell on their ears. Geddes finally turned the radio back to me, stepped away.

"They believe," he said. "Keep them informed. And they must keep us informed, too."

"Great Scott!" that was the voice of Rio, breaking in on me. "Judson Draper, I have to tell you something that is happening—this minute—here! Hailstones as big as marbles have just begun a dreadful cannonade on the roofs of Rio de Janeiro! They're coming more thickly, faster, and every second they become larger——"

I rushed out to tell Geddes, who had returned to the laboratory proper. He waved me aside. "Listen," he said.

I heard it, then, the sound as of many waters, all about us. Without thinking what I did, I took off my shirt. My body was bathed in perspiration, but up to this moment I had thought it caused solely by my growing terror—which was deep as the pit in which our disloyal robots had unearthed a city from a dim, foul past.

"Thank Heaven," said Geddes, "that we selected the highest point of land within miles. But when all the ice goes, it may be under water instead of ice!"

"Let it come," said Zora dully. "Let it come, and welcome. The sooner it covers us with oblivion, the better it will be for me!"

I walked to Zora, put my arms about her. "That isn't like you, Zora," I said simply. "No matter what happens to the world, there is always something in it for the living who love each other. We've got a fight on our hands. Let's carry it on."

A roar that could be only that caused by a hundred mighty avalanches broke in our ears. Geddes spoke softly, after it had died down, and the laboratory had threatened to fall about our heads. "Great fields of shelf ice," he said, "going out."

LIKE a man beside himself, I rushed back to the radio room. Rio was talking——

"—and the latest report is that huge blocks of ice on the Orinoco and the Amazon have stopped all river transport dead! Ice in Rio covers the sidewalks to a depth of two feet——"

New York cut in: *"The most destructive floods in history have struck New England, New York, Jersey and the Middle West——"*

I raced back to Geddes and Zora. As by common consent, we went to the door. The ice outside was mush under our feet. We looked away to the south in the eerie moonlight. Towering cliffs were showing through the ice—for the first time in many centuries. We looked at one another.

"We've done it, Sherm," I said. "Now, somehow, we've got to undo it."

"Yes," he groaned. "But how? If I could give my life——"

"Nothing could be done if that happened! You're the only person who can possibly—Sherm!—we've lost control, as you say, but have we lost control entirely? I can't believe it! If we had, how could we still hear the murmuring of that city? How could we hear those voices? How could we——"

Sherm's mouth hung open. A light of hope appeared in the eyes of Zora. We all rushed back into the laboratory.

Sherman Geddes stared at his precious table, at the wall panel. He picked up an ax, wetted his lips with a dry tongue. "All my life is in them," he said. "It is like destroying myself by inches——"

"Fail," said Zora, "and the whole world suffers! They are part of me, too, Sherman! But I'd sacrifice anything. I'd even sacrifice Judson Draper, when we've just found each other——"

Geddes went to work on the table with his ax. I grabbed something and Zora grabbed something. We were three mad people, destroying in minutes all that it had taken Sherman Geddes a lifetime to create.

When we had finished we were streaming sweat. We stood, staring at one another for minutes on end. So the last three people in the world, when the ultimate end came, might stare at one another. But even as we stared we heard more avalanches. More earthquakes dimmed our eyes with their trembling, more Niagaras of water were released to spill in horrible floods into the raging seas.

"There's one thing left," said Geddes, "and there's nothing left here for us. Tell the world that we're going south, ourselves, or at least that I am——"

"And I," I said simply.

"I, too," said Zora.

"And that we're going to match our wills against the wills of those people, in a last attempt to regain control of the power they've somehow—we can't even guess how—wrested from us."

I darted back to the microphone, told Rio.

"The world asks God to be with you, and make you strong to succeed," said Rio, terror in his shaking voice, "for if you fail——"

And there it ended. As the three of us, with bundles of food and clothing on our backs, started south, I couldn't help thinking of the utter futility of two men and a woman setting out to destroy what æons of time and untold icy tons had not conquered. Two men and a woman wading through slush to—futility.

Sherman Geddes knew that. Zora knew it. We went to escape that radio—and the yet-greater futility of waiting.

VI

THE ICE was going. Time after time, within a few miles of the camp we might well never see again, snow and ice slides almost caught us. But invariably we were warned in time, by the roaring sound—a sound which, heard in Antarctica, was like nothing heard anywhere else on the globe.

Water roared past us in many places, green and blue and black in the eerie moonlight. We stumbled along at top speed, none of us even thinking of fatigue. The ice was slush. Sherm Geddes led the way, of course, and the way was vaguely familiar—but only vaguely because of what the disrupted elements had done to ancient landmarks. We traveled the way that Mr. Seventeen had traveled before us!

And we found the field where the world stood on end, and it was a seething ferment of sluggishly moving, twisting, writhing slabs of ice through which, at intervals, stuck sharp or round rocks that were like the bones of monsters never seen on Earth to man's knowledge.

Rivers fled away, packed with ice. Time after time we saved one another from bottomless crevasses. Once a crevasse opened under Zora's feet, like the snapping jaws of a monster. I jerked her back, and the crevasse closed as quickly as it had opened—jaws that had missed their prey.

Geddes paused for a brief rest when we came to the mouth of the valley I would never forget. But we could not go into that valley because it was almost brim full of murmuring, roaring, whispering water. Brim full, and the surface packed and jammed with ice.

We took to the left rim, keeping just far enough back to keep from falling in if a misstep were taken.

"Sherm," I said finally, "I'm getting cold. I think we'd better put on more clothing——"

Geddes cried out. There was something of thanksgiving in his cry.

"I've been feeling it for half an hour," he said, "but I was afraid that it was wishful thinking. But if *you* are cold too——"

"I'm freezing," said Zora, "in spite of the speed we're making. My lungs are congealing, I'm sure."

"Heaven be thanked," said Geddes. "Here, I'll wrap something over your mouth to breathe through. And don't forget; when frostbite starts, knead the flesh with your fingers. But don't keep your fingers out in the open too long. Jud, watch her face for white spots. Watch mine, too. We'll watch and warn one another. We must not freeze——"

And so we watched one another, hawklike, as Sherm Geddes led us into the south, deeper and deeper. And now there was no denying that the cold was settling down as it had begun to settle weeks before, when the night had started, when the sun had vanished behind the edge of the frozen world.

Another hour, two hours, and Sherm Geddes paused again.

"There hasn't been an earthquake for half an hour," he said confidently, "nor any sound of ice going into Ross Sea, or

sliding down mountainsides. Antarctica is reverting to normal, or I'm a maniac. But we have to go on, have to make sure——"

And so we went, on and on, into the south. Twenty miles, thirty, forty. Occasionally we ate. Often we drank sparingly—and when the water we carried in special containers froze in spite of scientific proof that it could not freeze in those containers, we sucked at snow kicked up as we traveled. But we kept on and on. Zora moved with her head bowed. Now and again I tried to help her, with an arm about her shoulders. But she pushed me away.

"Not because I don't love you, Jud," she whispered, "but because you will need all that strength if we are to go back, and I'm a long way from the limit of my endurance. When I've reached that limit, I'll travel on nerve——"

"Guts!" said Geddes, with a lilt in his voice that made him sound like a delighted boy. "Let's keep moving."

WE STOPPED again, to rub at white spots of frostbite on our cheeks. And our fingers almost froze before we could put them back into our gloves. On and on——

We came, finally, to a sheet of ice that was as level as a floor. It stretched into the black night interminably. Geddes tested it.

"I think it goes down to solid earth," he said strangely. "Let's keep right on with it."

And keep on we did, hour after hour, hour after hour. When we had to rest we scooped out a place in the ice, surrounding ourselves with the blocks our picks had broken free, and sprawled together for warmth in the pit. But we couldn't go on sleeping, nor could all of us sleep at once. In that cold we could die without knowing it. We rose, went on. The cold was hideous, but now and again Sherman Geddes laughed aloud—laughed until the cold went into his mouth and froze his laughter.

We must have traveled for sixty hours —we'd all forgotten time as of no importance—when we came to a mighty rampart of snow and ice that seemed to reach to the moon. We could go no farther, and the icy precipice reached to the end of the world to right and left.

"Don't you recognize it?" asked Geddes softly, turning on us.

Then I got it. I should have guessed long ago. So should Zora, but neither of us had.

"And the city? The robots?"

"We're standing on it, and it's buried deeper by half a thousand feet than it was before. So are its people. So are the robots. *This* time they were not warned, those people we never met face to face. Can they save themselves again, in some century far distant in the future? Maybe. Let's go back."

Tired as we were, we were buoyed up by the knowledge that we had succeeded. Exactly how, we did not know. Nor did we know how the ancient ones had gained control of Sherman Geddes' robots. But when we tried to imagine what the intelligence of that race had been—how much more advanced it had been in human knowledge than was even Geddes —we were appalled. Human animation, suspended in ice for ages! The ability to listen to an alien tongue and understand it——

"You'll go back, Sherm," I said, "and tell the world. Before you're done, the world will insist that you come back here, try again; but that you make sure this time, before you come, that no power under heaven—literally—can usurp *your* power——"

"*You'll* tell the world," said Geddes grimly, "but only what you know. You can't tell the world all the secrets of my robots, for you don't know them. Even Zora doesn't know whence the power of the Geddes Rays was derived.

I've kept that to myself. Nothing could induce me to set those facts—or any of the secrets—down on paper. Some one might use my knowledge, come here—or go to the Arctic and loose some other catastrophe——"

"You'll change your mind," I told him as we trudged back through the abysmal cold. "You'll believe that you've foreseen all contingencies, including the intelligence of the people in the amphitheater—who may not have needed even the little warning they had, to preserve themselves—and that the next time you can capture and control the seasons!"

"Maybe," he said glumly, "for man is an egotist beyond compare, and I am the most egotistical of the lot. Even so, the world does pretty well with the seasons just as it finds them, doesn't it?"

"It has in our time; and in the time of our children it should be able to do just as well."

He was silent all the way back to the laboratory, where we found the Antarctic night normal. I radioed our story out. Reports came in that the phenomena which had startled the world had ceased. Other scientists had—when asked whether they believed these phenomena in any way related to the Geddes' reports from Antarctica—snorted that they were simply coincidental. Let the world believe that.

GEDDES brooded the months away, until the ice opened enough for a boat to reach us, more than four years short of the five years he had intended remaining on the frozen continent. Zora was concerned about him all the way out, for never once did he look back toward Antarctica, which had seen so many of his triumphs—which had been for years the heart of his dreams.

We were far beyond the last brigades of drifting icebergs when we vanished one night from the vessel that was taking us home——

"But I knew he'd do it," Zora said very softly. "It was the one sure way to close his mind so that no human power, ever, could rape it of secrets for which the world is not yet ready. Maybe some day a nephew of Sherm——"

Hot blood stained her cheeks when she realized what she was saying, understood the interpretation I could not help putting on it. But she faced me bravely, with that high courage of hers that so seldom faltered, and came into my arms at the rail, without finishing what she had started to say.

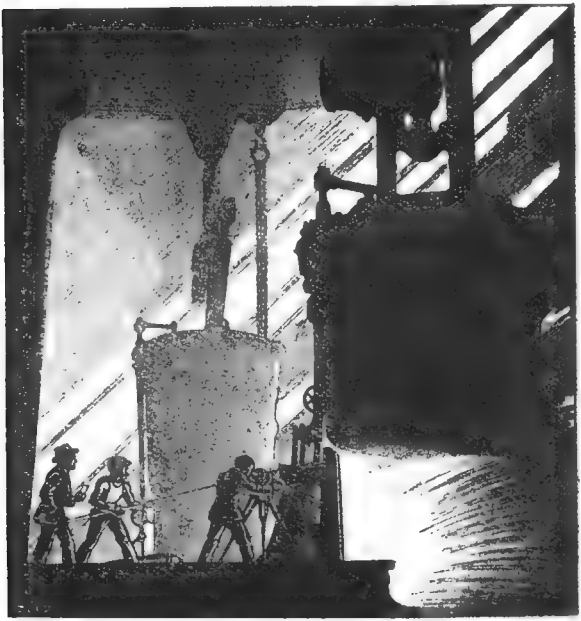
After all, there was no need for her to finish, when I knew what was in her mind. Yet even then I sort of hoped for daughters, lest there be too much of Sherman Geddes' ambition in any son of Zora's.

The Rainbow Bridge

by

Herbert C. McKay

Not a pot of gold but—more valuable—a pot of better steel lies at the other end of the Rainbow Bridge.



TEN centuries ago, the Vikings looked upon the rainbow as the bridge to Valhalla, across which warriors killed in battle were borne by beautiful Valkyries—but nine centuries served to bring the legend into disrepute. Only recently have we learned that the rainbow is truly a bridge to the heavens, one greater and more glorious than the Norsemen ever dreamed. Over this

colorful bridge we journey into the depths of space to discover the secrets of those flaming suns which we learn to call stars.

When first man dared to pry into the secrets of the Universe he was handicapped by the errors of his senses. Not until he realized that he could not "see" accurately, and prepared artificial eyes for himself, did he really begin to penetrate to the inner mysteries of Cosmos. One of these "eyes"—if we may call it such—is the spectroscope, that instrument which has been called the king of the laboratory. It leads us directly into the world of the electron, enables us to study radiation at its source and lays bare the very foundations of the Universe where matter becomes force and force becomes electricity! The spectroscope is, in exact truth, a radiation wave-length meter—the "scope" part of its name carried over from the days when its use was confined to visual radiation.

Although used in a thousand different ways, perhaps its deepest interest to us lies in the fact that through its aid science has dissected the atom and solved many of the problems of atomic and electronic reactions.

The name of the spectroscope is widely known and the elements of the science are taught in every high school. But in spite of this, it is perhaps less understood and more severely undervalued than any research instrument. To most of us the name means the spidery, little two- or three-armed instrument which stood upon the laboratory table, eaten up with corrosion. If this is true you should see the mazes of the infra-red spectroscope—the complexities of the X-ray spectroscope—the huge length of a Littrow spectrograph—or even a modern laboratory spectrophotometer. If you remember the tiny prism—alter your conception to include prisms of glass and of quartz and lithium fluoride, as well as polished crystalline surfaces. Or, in the diffraction type, transparent and reflecting gratings with as many as 25,000 accurately ruled lines to the inch. Spectroscopes are made in almost limitless variety, but their service is of more interest than the instruments themselves. Let us journey, in fancy, to several rooms, all in one large city——

IN A SMALL, smoke-clouded room two police officers and a man in civilian clothes turn eagerly as a fourth man—clad in a white laboratory coat—enters from another room.

"It's blood right enough, Lieutenant!"

"Are you sure? We can't afford any mistakes. Are you positive of your result?"

"The spectroscope shows oxidized hæmoglobin—and the spectroscope is a sure method of analysis. It *is* blood!"

"All right! Let's go, boys!"

LIQUID fire shot from the crucible into the moulds. A chemist peered from behind a metal shield at the fluid steel through a telescopic spectroscope, taking notes as he did so. After a moment he turned to the division superintendent, "All right, Jones, it's good."

In five minutes he had made a critical analysis of the metal without interrupting the manufacturing process.

THE manager of a large textile plant had complained to his chief chemist that a certain dye was not running true to form—a dye upon whose uniformity depended an order for a million yards of cloth. Two hours later the chemist reappeared.

"Here it is. The dye was all right, but this cloth we are turning out has an excess of calcium in it, and the dye reacts according to the variable calcium. Find where that comes from and the problem is solved."

"Thanks, Caldwell—I think I know how to cure that."

UNDER the rounded dome of an observatory in the outskirts of town, two men bent over a third who was reading a spectrographic plate. The observer rose and went to a calculating machine. Soon the only sound was the click and whir of the mechanical mathematician. After a few minutes the operator spoke without turning, "Mass about 20% of the Sun. Size seems to be about equal to that of the Earth."

Again the room was silent except for the noise of the machine, then the operator turned and wiped his forehead in a gesture of weary relief.

"Well, that's that. That is the densest star ever recorded—and it's less than five light-years distant."

HAGGARD and worried the doctor sat listening to the report of his laboratory assistant.

"—Doctor, we have not determined the true cause of the disturbance. Our 'causes' are merely symptoms. There is a decided deficiency of the new Hormone Q. I'm positive that is the true cause, and we have the extract here to supply that deficiency."

"But, Ferguson, how do you know? It takes three weeks to make that test and this case is only a day old."

"Beg pardon, Doctor—it takes about an hour and a half."

"What! How on earth can you do that?"

"The spectrograph, Doctor—in the ultraviolet region. The Raman Spectrum."

"Oh—that. Somehow I wonder how nearly right it is."

"The spectroscope is always right, Doctor—only our interpretation is sometimes wrong. In this case I have more than a thousand tests to prove the validity of the data I used in my interpretation."

"Marvelous if true, my lad. We'll see."

The patient was treated accordingly, and recovered.*

THE spectroscope is serving humanity in a thousand ways every minute of every day. It is indeed the magic car in which we travel the pathway of the Rainbow Bridge.

The principle of the spectroscope is not difficult to understand. We know that within the atom, electrons whirl about the nucleus in orbital paths. At intervals the electron jumps from one orbit to another. When this happens the lines of force between the electron and the nucleus are disturbed and an electro-magnetic wave is projected into space. This wave is known to us as radiation. Just as the electronic arrangement is specific for each element, so the radiations from jumping electrons are just as specific. The one difference is that there is a different specific jump characteristic for different conditions, conditions usually controlled by temperature or pressure or both. It is usually necessary to heat the material under examination to incandescence to induce the jumping which gives rise to the specific radiation. The absorption of cold gases, solutions and solids form one exception.

The spectroscope tells us what the electrons are doing as surely as if we could watch them individually under a super-microscope!

Inasmuch as the electronic jumps occur simultaneously or in ultra-rapid succession in millions of atoms, the radiation attains sufficient amplitude to be seen or to affect the photographic plate.

* Spectroscopy has not yet reached this degree of development, but as long ago as 1930 research under the sponsorship of Ellger was successful in the application of spectroscopic determinations of vitamins, purines, serum proteins and similar physiological complexes.

In spectroscopy as in other sciences, the photographic record has been found to be more accurate and more delicate than the eye. Because of this specific nature of the electronic activity, the radiation from any element is always specific and never duplicated by any other element. The spectrum is even more specifically characteristic than are fingerprints and more informative.

Therefore we can state a definite fact. *If* there is a sufficient amount of material incited to electronic activity to produce a perceptible radiation, and *if* we are already familiar with the charteristic radiation of that material, we can identify it beyond all question. The net result is that the spectroscope provides us with a means of elemental analysis more nearly absolute than any we have yet devised. For the identification of the elements we have published tables listing the characteristic lines of every element, so we do not have to possess this knowledge within our own minds. As for the other condition—the sufficient amount of material—it is interesting to learn the data regarding the delicacy of spectroscopic analyses. The following table indicates the fraction of a gram of material which the spectroscope will detect in a sample of material of the weight of one gram.

1.	Barium	1/1,000,000
2.	Potassium	1/1,000,000
3.	Rubidium	1/5,000,000
4.	Calcium	1/16,666,666
5.	Strontium	1/16,666,666
6.	Caesium	1/20,000,000
7.	Lithium	1/111,111,111
8.	Sodium	1/3,000,000,000

No, this is not a typographical error. If a gram sample contains sodium in the proportion of one part in three billion, the spectroscope will detect its presence! The practical result is that it is exceedingly difficult to obtain spectra entirely free from the tell-tale double sodium line near wave length 6000.*

But even the lowest average delicacy is one part in a million—and what ordinary chemical analysis will equal that in an original sample weighing one gram? At best we would enter "a trace" in the analysis. It is easy to understand why the spectroscope is ranked as the king of instruments. It reveals a hidden element which composes only a billionth part of a whole sample. Through thousands of light-years it brings us data concerning the make-up and motion of a nebula. And more prosaically it reveals metal poisons in canned food which might otherwise bring illness or death to hundreds.

DELICATE—complex—costly—the spectroscope which reigns in the research laboratory is but an elaboration of an instrument which any schoolboy of average ability can construct in a few hours. The heart of the simple spectroscope is a prism of glass which disperses light into the rainbow band, just as the bevel of a plate glass window casts a rainbow upon your luncheon cloth. True—we also use compound prisms, prisms of quartz, diffraction gratings and reflection from polished crystal surfaces for dispersion, but fundamentally the work is done by a simple, triangular prism of glass.

The primary function of the instru-

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* The extreme sensitivity of the spectroscope to the presence of sodium was one of the great stumbling blocks of early spectroscopy. To-day we know that sodium, and only sodium, gives that yellow line—that each element gives characteristic lines, and that only that element gives them. Before this was known and proven it was suggested, but opponents of the theory pointed out that the familiar yellow line—said to be due to sodium—did not follow the proposed rule. It was an exception, because any and all materials gave that yellow line. The purest potassium chloride gave a yellow line. Therefore, that yellow line, appearing everywhere, was an exception that—so they said—disproved the theory.

Actually, it is a practicable impossibility to eliminate that yellow line from potassium salts. In Europe—everywhere near the sea—the airborne salt spray from the sea is alone enough to give that yellow line—everywhere and always! Not until the immense sensitivity of the spectroscope was realized could that apparent anamoly be explained. —Editor.

ment—performed through this dispersion—is the measurement of radiation wave length. However, given knowledge of the wave length, we can accurately determine a wide variety of correlated facts. In a very real sense, this is a key instrument.

The dispersion of light into its components is a phenomenon known to every student of elementary physics. When light is bent from its path by either refraction or diffraction, the blue, or short, waves are bent more sharply than the long red ones. In short, there is a proportion between the wave length and the degree of departure from the original path. This is true of the ultraviolet and infra-red as well as of visible light, so that spectoscopy is not confined to visible radiation, but ranges from the infra-red upward to (in special cases) the X-ray region.

The dispersion obtained by refraction (prismatic) is non-uniform, the blue being disproportionately spread out. Diffraction dispersion is uniform in degree throughout. Thus a prismatic spectrum requires careful and tedious calibration by means of large groups of known spectral lines, while the diffraction spectrum may be calibrated with sufficient accuracy from the positions of only two known lines. Each type has compensating advantages in special work. Thus for different purposes we have instruments which disperse the light by passing it through a prism of glass or of quartz; and others which by passing the light through a diffraction grating on glass—or reflecting it from a similar grating on metal—obtain the uniform dispersion. The first are known as prismatic instruments, the latter as diffraction instruments.

The form of the prism is well-known, although many shapes are used in the spectroscope and at times as many as twelve prisms in a train are used. But the diffraction grating is not so familiar. It consists of a surface ruled with the utmost accuracy with parallel lines. Some gratings have upwards of 25,000 lines to the inch! In a grating, the finer the lines the greater the angle of dispersion, and the larger the area, the more critical the separation of the lines.

The diffraction method is perhaps more accurate, but several spectra are produced simultaneously at equal angles on each side of the normal. The first pair are the brightest, but it is obvious that the spectrum observed will be considerably less brilliant than the single one produced by the prism. For minute quantities, the prismatic instrument and a camera will record the result when the diffraction instrument would fail.

The essential parts of a good spectroscope are the slit, the collimator, the prism (or grating), the telescope, the shutters, the cross hairs and the eyepiece. The slit controls the definition. With a wide slit the lines overlap and become confused. The collimator makes the rays parallel. The prism or grating disperses the parallel beam; the telescope—adjusted for infinity—refocuses it. The shutters exclude portions of the spectrum not under examination, the cross hairs indicate the reading point, and the eyepiece brings the image into focus for individual eyesight. As a rule, the telescope swings to bring any desired portion of the spectrum beneath the cross hairs. In simpler instruments, a photographic scale is projected into the telescope, which has a fixed position. Such instruments are only approximately accurate.

ADJUNCTS include polarizing prisms for photometry and for spectroscopy by polarized light, cameras to replace the eyepiece, fluorescent screens to render ultraviolet visible, thermoelectric cells to read the radiations including the infra-red, spark gaps for spark spectra, arc burners for emission spectra, gas tubes for emission and absorption spectra and a host of others.

In any case, the spectrum is the band of separated wave lengths obtained by dispersing a mixed beam. As we have seen, this beam is usually produced by heating the material to a state of incandescence. When the material is a solid, a fluid, or a gas under pressure, the result is a general interference among electron groups. The orbital jumps are made non-uniform by collision and as a result the spectrum contains a wide variety of wave lengths. This results in a band of color which is a continuous shading of one color into another. This is known as a *continuous* spectrum. Its only great value is to serve as a background for absorption spectra.

If the material is a free gas, or a solid which has been volatilized in the arc crater or in a spark gap, the spectrum is no longer continuous, but made up of a series of colored lines on a black background. This is the characteristic *emission* spectrum of the element. Emission spectra produced in the arc often differ widely from those produced by a high-tension spark. One fundamental of spectroscopic examination is that the conditions under which the tests are made must be consistent.

If a transparent or translucent material is placed between the spectroscope and some luminous body which produces a continuous spectrum, black lines or bands will be seen. These, too, are specific. This is known as the *absorption* spectrum. The name *reversal* is applied to a specific type of absorption spectrum. If the transparent or translucent material is a gas cooler than the luminous source, a series of black lines will be seen. Examination shows that these lines are in exactly the same position that the emission bright lines of that same gas will occupy in its emission spectrum.

One of the first formulated observations in spectroscopy was the mapping of reversal lines. It is true that Newton observed prismatic dispersion of light, but as he used a circular opening to limit the beam, his observations were only superficial. In 1752 Melville remarked the relationship between sodium and the bright line in the spectrum in the region near 6000.

In the last century spectroscopy received real impetus, for in 1802 Wollaston substituted a slit for the circular aperture and produced distinct line images. He noticed a number of fine black lines crossing the spectrum of sunlight.

Twelve years later Fraunhofer made a study of these lines and mapped more than six hundred of them. Even then it was not known that these are the reversal lines of the gases which make up the intervening atmospheres—our own and the Sun's—but to-day we still call them "Fraunhofer" lines. But spectroscopy was under way. In 1826 Fox Talbot—who made the first photographs on paper and who foretold motion pictures—stated that spectral identification should be the basis of analysis. In 1835 he accurately described the spectra of lithium and strontium. It took until 1859 to formulate the science. That year Kirchoff and Bunsen performed this service for the world, and gave us the science of spectroscopic analysis.

ORIGINALLY no use for the instrument was known other than for chemical analysis, but it was the outstandingly popular branch of science in the last years of the nineteenth century. Later it sank into insignificance except in the astronomical laboratories where it has always been highly valued. In this science some amusing incidents have occurred. For example, in the spectra of some gaseous nebulæ a characteristic group of lines was found. After years of study it was mapped and as nothing like it was known on Earth, it was called Nebulium and gravely accepted by the scientific world of the day. In 1926 Dr. Eddington stated his opinion that eventually Nebulium would be identified with some familiar substance. In

1927 Bowen identified the strange substance as a mixture of oxygen and nitrogen.

The following year Dr. Eddington said, "Our confidence that the mysterious substance producing the spectrum of Nebulium would prove to be a familiar substance has been justified. Nebulium is—air!"

But not all celestial spectroscopic discoveries have been so ill-fated. Some years ago an element was discovered in the Sun and named for that luminary; astronomers were familiar with *helium* some thirty years before it was found on Earth and used to fill balloons.

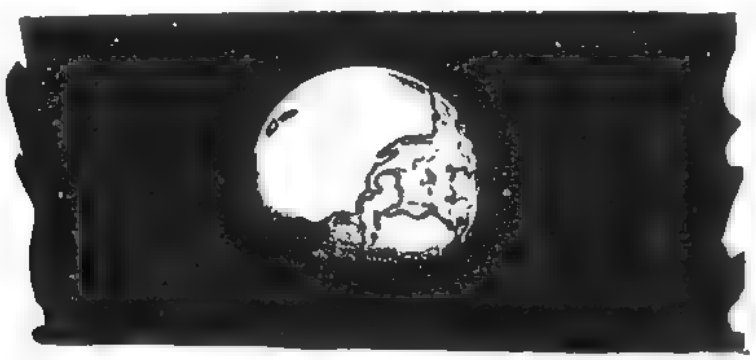
Even now we are confronted by a similar problem. Coronium—seen only in the Sun's corona at the instant of total eclipse. It, too, may prove to be an old friend, but as yet we do not know.*

Interest declined, or at least remained static, as long as the spectroscope was an instrument solely adapted to chemical analysis. It wasn't involved enough for the solemn scientists of a few decades ago. But when it was found that this instrument held possibilities infinitely greater, interest revived until at the present time it has been recrowned as the king of instruments. It tells us the rate of motion of the stars, their absolute magnitudes, resolves close double stars, tells the story of electronic motion and the mechanical structure of the atom. It analyzes color, analyzes chemical compounds, identifies the physiological trigger complexes such as vitamins, and promises to do the same for ferments, hormones and similar body chemicals. It controls the metals-manufacturing industries, aids in solving crimes, indicates incipient diseased conditions, controls the manufacture of photographic materials, has standardized printing inks and other pigments.

Those engaged in astrophysics know the tremendous value of this instrument, while simpler models are found in thousands of laboratories devoted to biology, chemistry, criminology, medicine, dye industries and photography. But the field of greatest human service destined to be served by the spectroscope is the one into which it entered last of all—the clinical field. When it makes laboratory diagnosis a matter of minutes rather than of days—days in which a patient may die—it will mean another tremendously powerful bulwark erected against the ravages of disease.

The spectroscope marches on to open wide the doors guarding the secrets of the universe—but also turns aside to the more humane activity of saving human life and health. Truly the hard-bitten Vikings undervalued their Rainbow Bridge.

* Coronium has been provisionally identified as oxygen under conditions utterly unattainable on Earth. Mathematical work from atomic theory permits this identification. —Editor.



Galactic Patrol

By

E. E. SMITH, Ph.D.

The last and greatest installment of Dr. Smith's greatest novel.

XXI.

BUT BLAKESLEE, the chief communications officer whose mind and body Kinnison was using, was already armed. Kinnison had seen to that. And as the base commander wrenched open the arms cabinet that happened for which the Lensman had been waiting. Helmuth's private lookout set began to draw current; that potentate himself was now looking on, and the enslaved observer had already begun to trace his beam. Therefore, as the raging commander of Boyssia's pirate base swung about with raised DeLameter he faced one already ablaze; and in a matter of seconds there was only a charred and smoking heap where the commander had stood.

Kinnison wondered that Helmuth's cold voice was not already snapping from the speaker, but he was soon to discover the reason for that silence. Unobserved by the Lensman, one of the observers had recovered sufficiently from his shocked amazement to turn in a riot alarm to the guard room. Five armed men answered that call on the double, stopped and glanced around.

"Guards! Blast Blakeslee down!" Helmuth's unmistakable voice blared from his speaker.

Obediently and manfully enough the five guards tried; and, had it actually been Blakeslee confronting them so defiantly, they probably would have succeeded. It was the body of the communications officer, it is true. The mind operating the muscles of that body, however, was the mind of Kimball Kinnison, gray Lensman, the fastest man with a ray pistol old Tellus had ever produced; keyed up, expecting the move, and with two DeLameters out and poised at hip! *This* was the being whom Helmuth was so nonchalantly ordering his minions to slay! Faster than any watching eye could follow, five bolts of lightning flicked from Blakeslee's DeLameters. The last guard went down, his head a shriveled cinder, before a single pirate bolt could be loosed.

"You see, Helmuth," Kinnison spoke conversationally to the board, his voice dripping vitriol, "playing it safe from a distance, and making other men pull your chestnuts out of the fire, is a very fine trick as long as it works. But when it fails to work, as now, it puts your tail right into the wringer. I, for one, have been for a long time completely fed up on taking orders from a mere voice; especially from the voice of one whose entire method of operation proves him to be the most pitifully arrant coward in the galaxy."

"Observer! You other at the board!" snarled Helmuth, paying no attention to Kinnison's barbed shafts. "Sound the assembly—armed!"

"No use, Helmuth, he is stone deaf," Kinnison explained, voice sweetly venomous. "I am the only man in this base

that you can talk to, and you won't be able to do even that very much longer."

"And you really think that you can get away with this mutiny—this barefaced insubordination—this defiance of *my* authority?"

"Sure I can. That's what I have been explaining to you. If you were here in person, or ever had been; if any of the boys had ever seen you, or had ever known you as anything except a

An instant later Helmuth's viewplate vanished in the DeLameter's blaze.

disembodied voice, maybe I couldn't. But, since nobody has ever seen even your face, that gives me a chance——"

IN HIS distant base Helmuth's mind had flashed over every aspect of this unheard-of situation. He decided to play for time; therefore, even as his hands darted to buttons here and there, he spoke. "Do *you* want to see my face?" he demanded. "If you do see it, no power in the galaxy——"

"Skip it, chief," sneered Kinnison. "Don't try to kid me into believing that

you wouldn't kill me now, under any conditions, if you possibly could. As for your face, it makes no difference whatever to me, now, whether I ever see your ugly pan or not."

"Well, you shall!" And Helmuth's visage appeared, concentrating upon the rebellious officer a glare of such fury and such power that any ordinary man must have quailed. But not Blakeslee-Kinnison!

"Well! Not so bad, at that—the guy looks almost human!" Kinnison exclaimed, in the tone most carefully designed to drive even more frantic the helpless and inwardly raging pirate chieftain. "But I've got things to do. You can guess at what goes on around here from now on." And in the blaze of a DeLameter Helmuth's plate, set, and "eye" disappeared. Kinnison had also been playing for time, and his enslaved observer had checked and rechecked this second and highly important line to Helmuth's ultra-secret base.

Then, throughout the fortress, there blared out the urgent assembly call, to which the Lensman added, verbally: "This is a one-hundred-per-cent callout, including crews of ships in dock as well as regular base personnel. Bring also the patrol nurses. Come as you are and come fast. The doors of the auditorium will be locked in five minutes and any man outside those doors will be given ample reason to wish that he had been on time."

THE AUDITORIUM was right off the control room, and was so arranged that when a partition was rolled back the control room became its stage. All Boskonian bases were arranged thus, in order that the supervising officers at Grand Base could oversee, through their instruments upon the main panel, just such assemblies as this one was supposed to be. Every man hearing that call assumed that it came from Grand Base, and every man hurried to obey it.

Kinnison rolled back the partition between the two rooms and watched for ray pistols, as the men came streaming into the auditorium. Ordinarily only the guards went armed—three of them were left—but possibly a few of the ship's officers would be wearing their DeLameters. . . . Four—five—six—the captain and the pilot of the battleship that had captured the nurses, and a vice commander of another, besides the three guards. Knives, billies, and such did not count.

"Time's up. Lock the doors. Bring the keys and the nurses up here," he ordered the six armed men, calling each by name. "You women take these chairs over here; you men sit there."

Then, when all were seated, Kinnson touched a button and the steel partition slid smoothly into place.

"What's coming off here?" demanded a guard. "Where's the commander? How about Grand Base? Look at that board!"

"Sit tight," Kinnison directed. "Hands on knees. I'll burn any or all of you that make a move. I have already burned the old man and five guards, and have put Grand Base out of the picture. Now I want to find out just how we seven stand." The Lensman already knew, but he was not tipping his hand.

"Why we seven?"

"Because we are the only ones who happened to be wearing guns. Every one else of the entire personnel is unarmed and is now locked in the auditorium. You know how apt they are to get out until one of us lets them out."

"But Helmuth—he'll have you blasted for this!"

"Hardly. My plans were not made yesterday. How many of you fellows are with me?"

"What's your scheme?" demanded the vice commander.

"To take these nurses to some patrol base and surrender. I'm sick of this

whole game; and, since none of them have been hurt, I figure they'll bring us a pardon and a fresh start—a light sentence at least."

"Oh, so *that's* the reason——" growled the captain.

"Exactly. But I don't want any one with me whose only thought would be to burn me down at the first opportunity."

"Count me in," declared the pilot. "I've got a strong stomach, but enough of these jobbies is altogether too much. If you can wangle anything short of a life sentence for me I'll go back, but I bloody well won't help you against the——"

"Sure not. Not until after we're out in space. I don't need any help here."

"Do you want my DeLameter?"

"No, keep it. You won't use it on me. Anybody else?"

One guard joined the pilot, standing aside; the other four wavered.

"Time's up!" Kinnison snapped. "Now, you four fellows, either go for your guns or else turn your backs, and do it right now!"

They elected to turn their backs and Kinnison collected their weapons, one by one. Having disarmed them, he again rolled back the partition and ordered them to join the wondering throng in the auditorium. He then addressed the assemblage, telling them what he had done and what he had it in mind to do.

"A good many of you must be fed up on this lawless game of piracy and anxious to resume association with decent men, if you can do so without incurring too great a punishment," he concluded. "I feel quite certain that those of us who man the hospital ship in order to return these nurses to the patrol will get light sentences, at most. Miss MacDougall is head nurse. We will ask her what she thinks."

"Better than that," Mac replied clearly. "I am not merely 'quite certain,' either—I am absolutely sure that whatever men Mr. Blakeslee selects for his crew will not be given any sentences at all. They will be pardoned, and will be given chances at jobs in the merchant service."

"How do you know, miss?" asked one. "We're a black lot."

"I know you are," she replied serenely. "I won't say how I know, but you can take my word for it that I *do* know."

"THOSE of you who want to take a chance with us line up over here," Kinnison directed, and walked rapidly down the line, reading the mind of each man in turn. Many of them he waved back into the main group, as he found thoughts of treachery or signs of inherent criminality. Those he selected were those who were really sincere in their desire to quit forever the ranks of Boskone, those who were in those ranks because of some press of circumstance rather than because of a mental taint. As each man passed inspection he armed himself from the cabinet and stood at ease before the group of women.

Having selected his crew, the Lensman operated the controls that opened the exit nearest the hospital ship, blasted away the panel, so that that exit could not be closed, unlocked a door, and turned to the pirates.

"Vice Commander Krimsky, as senior officer you are now in command of this base," he remarked. "While I am in no sense giving you orders, there are a few matters about which you should be informed. First, I set no definite time as to when you may leave this room. I merely state that you will find it decidedly unhealthy to follow us at all closely as we go from here to the hospital ship. Second, you haven't a ship fit to take the ether, as your blast levers have all been broken off at the pivots. If your mechanics work at top speed, new ones can be put on in exactly two

hours. Third, there is going to be a very severe earthquake in precisely two hours and thirty minutes, one which should make this base merely a memory."

"An earthquake! Don't bluff, Blakeslee. You couldn't do *that!*"

"Well, perhaps not a regular earthquake, but something that will do just as well. If you think I am bluffing, wait and find out. But common sense should give you the answer to that. I know exactly what Helmuth is doing now, whether you do or not. At first I intended to wipe you all out without warning, but I changed my mind. I decided that I would rather leave you alive, so that you could report to Helmuth exactly what happened. I wish that I could be watching him when he finds out how badly one man rooked him, and how far from foolproof his system is. But we can't have everything. Let's go, folks!"

As the group hurried away, Mac loitered until she was near the form of Blakeslee, who was bringing up the rear.

"Where are you, Kim?" she whispered urgently.

"I'll join up at the next corridor. Keep further ahead, and get ready to run when we do!"

AS THEY PASSED that corridor a figure in gray leather, carrying an extremely heavy object, stepped out of it. Kinnison himself set his burden down, yanked a lever, and ran. And as he ran fountains of intolerable heat erupted and cascaded from the mechanism he had left upon the floor. Just ahead of him, but at some distance behind the others, ran Blakeslee and Mac.

"Gosh, I'm glad to see you, Kim!" she panted, as the Lensman caught up with them and all three slowed down. "What is that thing back there?"

"Nothing much—just a KJ4Z hotshot. Won't do any real damage—just melt this tunnel down so that they can't interfere with our get-away."

"Then you *were* bluffing about the earthquake?" she asked, a shade of disappointment in her tone.

"Hardly," he reproved her. "That isn't due for two hours and a half yet, but it'll happen on schedule time."

"How?"

"You remember about the curious cat, don't you? However, no particular secret about it, I guess—ten duodec bombs placed where they'll do the most good, and timed for exactly simultaneous detonation. Here we are. Don't tell anybody I'm here."

Aboard the vessel, Kinnison disappeared into a stateroom while Blakeslee continued in charge. Men were divided into watches; duties were assigned; inspections were made, and the ship shot into the air. There was a brief halt to pick up Kinnison's speedster; then, again on the way, Blakeslee turned the board over to Crandall, the pilot, and went into Kinnison's room.

There the Lensman withdrew his control, leaving intact the memory of everything that had happened. For minutes Blakeslee was almost in a daze, but struggled through it and held out his hand.

"Mighty glad to meet you, Lensman. Thanks. All I can say is that after I got sucked in I couldn't——"

"Sure, I know all about it. That was one of the reasons I picked you out. Your subconsciousness didn't fight back a bit, at any time. You are to be in charge, from here to Tellus. Please go and chase everybody out of the control room except Crandall."

"Say, I just thought of something!" exclaimed Blakeslee, when Kinnison joined the two officers at the board. "You must be that particular Lensman who has been getting in Helmuth's hair so much lately!"

"Probably. That's my chief aim in life."

"I'd like to see Helmuth's face when he gets the report of this. I've said that before, haven't I? But I mean it now, even more than I did before."

"I'm thinking of Helmuth, too, but not that way." The pilot had been scowling at his plate, and now turned to Blakeslee and the Lensman, glancing curiously from one to the other. "Oh, I say—— A Lensman, what? A bit of good old light begins to dawn; but that can wait. Helmuth is after us, foot, horse, and marines. Look at that plate!"

"Four of them already!" exclaimed Blakeslee. "And there's another! And we haven't got a beam hot enough to light a cigarette, nor a screen strong enough to stop a firecracker. We've got legs, but not as many as Helmuth's fliers. You knew all about that, though, of course, before we started; and from what you have pulled off so far you've got something left on the hooks. What is it? What's the answer?"

"Indetectability," replied Kinnison. "We can detect them, but they can't detect us. All you have to do is to stay out of range of their electros and drill for Tellus."

"That's hard to believe, but it must be true. There are nine ships on the plates now; all Boskonians and all certainly looking for us, but not a one of them has paid any attention to us."

"Nor will they. And, by the way, who or what is Boskone?"

"Nobody knows. Helmuth speaks for Boskone, and nobody else ever does, not even Boskone himself—if there is such a person. Nobody can prove it, but everybody knows that Helmuth and Boskone are simply two names for the same man. Helmuth, you know, is only a voice. Nobody ever saw his face until to-day."

"I'm beginning to think so, myself." And Kinnison strode away, to call at the office of Head Nurse MacDougall.

"Mac, here's a small, but highly important box," he told her, taking the neutralize from his pocket and handing it to her. "Put it in your locker until you get to Tellus. Then take it, yourself, and give it to Haynes, himself, in person, and to nobody else. Just tell him I sent it. He'll know all about it."

"But why not keep it and give it to him yourself? You're coming with us, aren't you?"

"Probably not all the way. I imagine I'll have to shove off before we get back to Tellus."

"But I want to talk to you!" she exclaimed. "Why, I've got a million questions to ask you!"

"That would take a long time"—he grinned at her—"and time is just what we don't have right now, either of us." And he strode back to the board.

HE LABORED for hours at a calculating machine and in the tank; finally to squat down upon his heels, staring at two needlelike rays of light in the tank and whistling softly between his teeth. For those two lines, while exactly in the same plane, did not intersect in the tank at all! Estimating as carefully as he could the point of intersection of the lines, he punched the "cancel" key to wipe out all traces of his work and went to the chart room. Chart after chart he hauled down, and for many minutes he worked with calipers, compass, goniometer, and a carefully set adjustable triangle. Finally he marked a point—exactly upon a small, plain dot already upon the chart—and again whistled.

"Huh!" he grunted. He rechecked all his figures and retraversed the chart, only to have his needle pierce again the same tiny, unmarked dot. He stared at it for a full minute, studying the map all around his marker.

"Star Cluster AC 257-4736," he ruminated. "The smallest, most insignificant, least-known star cluster he could find, and my largest possible error can't

put it anywhere else. Kind of thought it might be in a cluster, but I never would have looked *there*. No wonder it took a lot of stuff to trace his beam. It would have to be four numbers Brinnell harder than a diamond drill to work from there."

Again whistling tunelessly to himself, he rolled up the chart upon which he had been at work, stuck it under his arm, replaced the others in their compartments, and went back to the control room.

"How's tricks, fellows?" he asked.

"QX," replied Blakeslee. "We're through them and into clear ether. Not a ship on the plate, and nobody gave us even a tumble."

"Fine! You won't have any trouble, then, from here in to Prime Base. Glad of it, too. I've got to flit. That'll mean long watches for you two, but it can't very well be helped."

"But I say, old bird, I don't mind the watches, but——"

"Don't worry about that, either. This crew can be trusted, to a man. Not one of you joined the pirates of your own free will, and not one of you has ever taken an active part——"

"What are you, a mind reader or something?" Crandall burst out.

"Something like that," Kinnison assented with a grin.

Blakeslee put in, "More than that, you mean. Something like hypnosis, only more so. You think that I had something to do with this, but I didn't. The Lensman did it all himself."

"Um-m-m." Crandall stared at Kinnison, new respect in his eyes. "I knew that unattached Lensmen were good, but I had no idea they were *that* good. No wonder Helmuth has been getting his wind up about you. I'll string along with any one who can take a whole base, single-handed, and make such a bally ass to boot out of such a keen old bird as Helmuth is. But I'm in a bit of a dither, not to say a funk, about what is going to happen when we pop into Prime Base without you. Every man jack of us, you know, is slated for the lethal chamber without trial. Miss MacDougall will do her bit, of course, but what I mean is, has she enough jets to swing it?"

"I think that she has; but to avoid all argument I've fixed that up, too. Here's a tape, telling all about what happened. It ends up with my recommendation for a full pardon for each of you, and for a job at whatever he is found best fitted for. It is signed with my thumb print. Give it or send it to Port Admiral Haynes as soon as you land. I've got enough jets, I think, so that it will go as it lays."

"Jets? You? Right-o! You've got jets enough to lift fourteen freighters off the North Pole of Valeria. What next?"

"Stores and supplies for my speedster. I'm doing a long flit and this ship has supplies to burn, so I'd like to have my little can loaded, Plimsoll down."

THE SPEEDSTER was stocked forthwith. Then, with nothing more than a casually waved salute in the way of farewell, Kinnison boarded his tiny space ship and shot away toward his distant goal. Crandall, the pilot, sought his bunk; while Blakeslee started his long trick at the board. In an hour or so the head nurse strolled in.

"Kim?" she queried, doubtfully.

"No, Miss MacDougall. It's Blakeslee. Sorry——"

"Oh, I'm glad of that. That means that everything is settled. Where's the Lensman—in bed?"

"He has gone, miss."

"Gone! Without a word? Where?"

"He didn't say."

"He wouldn't, of course." The nurse turned away, exclaiming inaudibly, "Gone! I'd like to cuff him for that, the lug! *Gone!* Why, the great, big, lobsterly clunker!"

XXII.

BUT KINNISON was not heading for Helmuth's base—yet. He was splitting the ether toward Aldebaran instead, as fast as his speedster could go; and she was one of the fastest things in the galaxy. He had two good reasons for going there before he attempted Boskone's Grand Base: first, to try out his skill upon nonhuman intellects—if he could handle the Wheelmen he was ready to take the far greater hazard; second, he owed those Wheelmen something, and he did not like to call in the whole patrol to help him pay his debts. He could, he thought, handle that base himself.

Knowing exactly where it was, he had no difficulty in finding the volcanic shaft which formed the entrance to that Aldebaranian base. Down that shaft his sense of perception sped. He found the lookout plates and followed their power leads. Gently, carefully, he insinuated his mind into that of the Wheelman at the board, discovering, to his great relief, that that monstrosity was no more difficult to handle than had been the Radeligian observer. Mind or intellect, he found, were not affected at all by the shape of the brains concerned; quality, reach, and power were the essential factors.

Therefore, he let himself in and took position in the same room from which he had been driven so violently. Kinnison examined with interest the wall through which he had been blown, noting that it had been repaired so perfectly that he could scarcely find the joints which had been made.

These Wheelmen, the Lensman knew, had explosives; since the bullets which had torn their way through his armor and through his flesh had been propelled by that agency. Therefore, to the mind within his grasp he suggested "the place where explosives are kept?" and the thought of that mind flashed to the storeroom in question. Similarly, the thought of the one who had access to that room pointed out to the Lensman the particular Wheelman he wanted. It was as easy as that. And since he took care not to look at any of the weird beings, he gave no alarm.

Kinnison withdrew his mind delicately, leaving no trace of its occupancy, and went to investigate the arsenal. There he found a few cases of machine-rifle cartridges, and that was all. Then he went into the mind of the munitions officer, where he discovered that the heavy bombs were kept in a distant crater, so that no damage would be done by any possible explosion.

"Not quite as simple as I thought," Kinnison ruminated. "But there's a way out of that, too."

There was. It took an hour or so of time; and he had to control two Wheelmen instead of one, but he found that he could do that. When the munitions master took out a bomb-scow after a load of H. E., the crew had no idea that it was anything except a routine job. The only Wheelman who would have known differently, the one at the lookout board, was the other whom Kinnison had to keep under control. The scow went out, got its load, and came back. Then, while the Lensman was flying out into space, the scow dropped down the shaft. So quietly was the whole thing done that not a creature in that whole establishment knew that anything was wrong until it was too late to act—and then none of them knew anything at all. Not even the crew of the scow realized that they were dropping too fast.

Kinnison didn't know what would happen if a mind—to say nothing of two of them—died while in his mental grasp, and he did not care to find out. Therefore, a fraction of a second before the crash, he jerked free and watched.

The explosion and its consequences did not look at all impressive from the

Lensman's coign of vantage. The mountain trembled a little, then subsided noticeably. From its summit there erupted an unimportant little flare of flame, some smoke, and an insignificant shower of rock and débris.

However, when the scene had cleared there was no longer any shaft leading downward from that crater; a floor of solid rock began almost at its lip. Nevertheless, the Lensman explored thoroughly all the region where the stronghold had been, making sure that the clean-up had been one-hundred-per-cent effective.

Then, and only then, did he point the speedster's streamlined nose toward Star Cluster AC 257-4736.

IN HIS hidden retreat so far from the galaxy's crowded suns and worlds, Helmuth was in no enviable or easy frame of mind. Four times he had declared that that accursed Lensman, whoever he might be, must be destroyed, and had mustered his every available force to that end, only to have his intended prey slip from his grasp as effortlessly as a droplet of mercury eludes the clutching fingers of a child.

That Lensman, with nothing except a speedster and a bomb, had taken and had studied one of Boskone's new battleships, thus obtaining for his patrol the secret of cosmic energy. Abandoning his own vessel, then crippled and doomed to capture or destruction, he had stolen one of the ships searching for him and in it he had calmly sailed to Velantia, right through Helmuth's screen of blockading vessels. He had in some way so fortified Velantia as to capture six more Boskonian battleships. In one of those ships he had won his way back to the Prime Base of the patrol, with information of such immense importance that it had robbed the Boskonian organization of its then overwhelming superiority.

More, he had found or had developed new items of equipment which, save for Helmuth's own success in obtaining them, would have given the patrol a definite and decisive superiority over Boskonia. Now both sides were again equal, except for that Lensman and—the Lens.

Helmuth still quailed inwardly whenever he thought of what he had undergone at the Arisian barrier, and he had given up all thought of securing the secret of the Lens by force or from Arisia. But there must be other ways of getting it——

And just then there came in the urgent call from Boyssia II, followed by the stunningly successful revolt of the hitherto innocuous Blakeslee, culminating as it did in the destruction of Helmuth's every Boyssian device of vision or of communication. Blue-white with fury, the Boskonian high chief flung his net abroad to take the renegade; but as he settled back to await results a thought struck him like a blow from a fist: Blakeslee *was* innocuous. He never had had, did not now and never would have, the cold nerve and the sheer, dominating power he had just shown. Toward what conclusion did that fact point?

The furious anger disappeared from Helmuth's face as though it had been wiped therefrom with a sponge, and he became again the coldly calculating mechanism of flesh and blood that he ordinarily was. This conception changed matters entirely. This was not an ordinary revolt of an ordinary subordinate. The man had done something which he could not possibly do. So what? The Lens again. Again that accursed Lensman, the one who had somehow learned really to *use* his Lens!

"Wolmark, call every vessel at Boyssia base," he directed, crisply. "Keep on calling them until some one answers. Get whoever is in charge there now and put him on me here."

A few minutes of silence followed, then Vice Commander Krimsky reported

in full everything that had happened and told of the threatened destruction of the base.

"You have an automatic speedster there, have you not?"

"Yes, sir."

"Turn over command to the next in line, with orders to move to the nearest base, taking with him as much equipment as is possible. Caution him to leave on time, however, for I very strongly suspect that it is now too late to do anything to prevent the destruction of the base. You, alone, take the speedster and bring away the personal files of the men who went with Blakeslee. A speedster will meet you at a point to be designated later and relieve you of the records."

AN HOUR PASSED—two, then three.

"Wolmark! Blakeslee and the hospital ship have vanished, I presume?"

"They have." The underling, expecting a verbal flaying, was greatly surprised at the mildness of his chief's tone and at the studious serenity of his face.

"Come to the center." Then, when the lieutenant was seated, "I do not suppose that you as yet realize what—or rather, who—it is that is doing this?"

"Why, Blakeslee is doing it, of course."

"I thought so, too, at first. That was what the one who really did it wanted us to think."

"It must have been Blakeslee. We saw him do it, sir. How could it have been any one else?"

"I do not know. I do know, however, and so should you, that he could not have done it. Blakeslee, of himself, is of no importance whatever."

"We'll catch him, sir, and make him talk. He can't get away."

"You will find that you will not catch him and that he can get away. Blakeslee alone, of course, could not do so, any more than he could have done the things he apparently did do. No, Wolmark, we are not dealing with Blakeslee."

"Who then, sir?"

"Haven't you deduced that yet? The Lensman, fool—the same Lensman who has been thumbing his nose at us ever since he took one of our first-class battleships with a speed boat and a firecracker."

"But—great blinding rockets, how?"

"Again I admit that I do not know—yet. The connection, however, is quite evident—thought. Blakeslee was thinking thoughts utterly beyond him. The Lens comes from Arisia. The Arisians are masters of thought—of mental forces and processes incomprehensible to any of us. These are the elements which, when fitted together, will give us the complete picture."

"Still I don't see how they fit."

"Neither do I—yet. However, it should be clear to you that we do not want that Lensman thinking such thoughts as that into this base."

"We certainly do not. However, surely he can't trace——"

"Just a moment! The time has come when it is no longer safe to say what that Lensman cannot do. Our communicator beams are hard and tight, yes. But any beam can be tapped if enough power be applied to it, and any beam that can be tapped can be traced. I expect him to visit us here, and we shall be prepared for his visit. That is the reason for this conference with you. Here is a device which generates a field through which no thought can penetrate. I have had this device for some time, but for obvious reasons have not released it. Here are the diagrams and complete constructional data. Have a few hundred of them made with all possible speed, and see to it that every being upon this planet wears one continuously. Impress upon every one, and I will also, that it is of the utmost importance that absolutely continuous protection be

maintained, even while changing batteries.

"Experts have been working for some time upon the problem of protecting the entire planet with such a screen, and there is some little hope of success in the near future; but individual protection will still be of the utmost importance. We cannot impress it too forcibly upon every one that every man's life is dependent upon each one maintaining his thought screen in full operation at all times. That is all."

WHEN the messenger brought in the personal files of Blakeslee and the other deserters, Helmuth and his psychologists went over them with minutely painstaking care. The more they studied them the clearer it became that the chief's conclusion was the correct one. Some one had, in some way, brought an extraordinary mental pressure to bear.

Reason and logic told Helmuth that the Lensman's only purpose in attacking the Boyssian base was to get a line on Grand Base; that Blakeslee's flight and the destruction of the base were merely diversions to obscure the real purpose of the visit; that the Lensman had staged that theatrical performance especially to hold him, Helmuth, while his beam was being traced, and that that was the only reason why the visiset was not sooner put out of action; and, finally, that the Lensman had scored another clean hit.

He, Helmuth himself, had been caught flat-footed. His face hardened and his jaw set at the thought. But he had not been taken in. He was forewarned and he would be ready, for he was coldly certain that Grand Base and he himself were the real objectives of the Lensman. That Lensman knew full well that any number of ordinary bases, ships, and men could be destroyed without damaging, materially, the Boskonian cause.

Steps must be taken to make Grand Base as impregnable to mental forces as it already was to physical ones. Otherwise, it might well be that even Helmuth's own life would presently be at stake, and that life was a thing precious indeed. Therefore, council after council was held; every contingency that could be thought of was brought up and discussed; every possible precaution was taken. In short, every resource of Grand Base was devoted to the warding off of any possible mental threat which might be forthcoming.

KINNISON approached that star cluster with care. Small though it was, as cosmic groups go, it yet was composed of some hundreds of stars and an unknown number of planets. Any one of those planets might be the one he sought, and to approach it unknowingly might prove disastrous. Therefore, he slowed down to a crawl and crept up, light year by light year, with his ultra-powered detectors fanning out before him to the limit of their unimaginable reach.

He had more than half expected that he would have to search that cluster, world by world; but in that, at least, he was pleasantly disappointed. One corner of one of his plates began to show a dim glow of detection. A bell tinkled and Kinnison directed his most powerful master plate into the region indicated. This plate, while of very narrow field, had tremendous resolving power and magnification; and in it he saw that there were eighteen small centers of radiation surrounding one vastly larger one.

There was no doubt then as to the location of Helmuth's base, but there arose the question of approach. The Lensman had not considered the possibility of a screen of lookout ships. If they were close enough together so that their electromagnetics had even a fifty-per-cent overlap, he might as well go

back home. What were those outposts, and exactly how closely were they spaced? He observed, advanced, and observed again; computing finally that, whatever they were, they were so far apart that there could be no possibility of any electro overlap at all. He could get between them easily enough. He wouldn't even have to baffle his flares.

They could not be guards at all, Kinnison concluded, but must be simply outposts, set far outside the solar system of the planet they guarded; not to ward off one-man speedsters, but to warn Helmuth of the possible approach of a force large enough to threaten the Grand Base of Boskonia.

Closer and closer Kinnison flashed, discovering that the central object was indeed a base, startling in its immensity and completely and intensively fortified; and that the outposts were huge, floating fortresses, practically stationary in space relative to the sun of the solar system they surrounded. The Lensman aimed at the center of the imaginary square formed by four of the outposts and drove in as close to the planet as he dared. Then, going inert, he set his speedster into an orbit—he did not care particularly about its shape, provided that it was not too narrow an ellipse—and cut off all his power. He was now safe from detection. Leaning back in his seat and closing his eyes, he hurled his sense of perception into and through the massed fortifications of Grand Base.

For a long time he did not find a single living creature. He traversed hundreds of miles, perceiving only automatic machinery, bank after towering, mile-square bank of accumulators, and remote-controlled projectors and other weapons and apparatus. Finally, however, he came to Helmuth's dome; and in that dome he received another severe shock. The personnel in that dome were to be numbered by the hundreds, but he could not make mental contact with any one of them. He could not touch their minds at all; he was stopped cold. Every member of Helmuth's band was protected by a thought screen as effective as the Lensman's own!

Around and around the planet the speedster circled, while Kinnison struggled with this new and entirely unexpected setback. This looked as though Helmuth knew what was coming. Helmuth was nobody's fool, Kinnison knew; but how could he possibly have suspected that a mental attack was in the book? Perhaps he was just playing safe. If so, the Lensman's chance would come. Men would be careless; batteries weakened and would have to be changed.

But this hope was also vain, as continued watching revealed that each battery was listed, checked, and timed. Nor was any screen released, even for an instant, when its battery was changed; the fresh power source being slipped into service before the weakening one was disconnected.

"Well, that proves that Helmuth *knows,*" Kinnison cogitated, after watching vainly several such changes. "He's a wise old bird. The guy really has jets. I still don't see what I did that could have put him wise to what was going on."

DAY AFTER DAY the Lensman studied every detail of construction, operation, and routine of that base, and finally an idea began to dawn. He shot his attention toward a barracks he had inspected frequently of late, but stopped, irresolute.

"Uh-uh, Kim, maybe better not," he advised himself. "Helmuth's mighty quick on the trigger, to figure out that Boyssian thing so fast——"

His projected thought was sheared off without warning, thus settling the question definitely. Helmuth's big apparatus was at work; the whole planet was screened against thought.

"Oh, well, probably better, at that," Kinnison went on arguing with himself.

"If I'd tried it out maybe he'd have got onto it and laid me a stymie next time, when I really need it."

Since he had accomplished everything that he could do for the time being, he went free and hurled his speedster toward Earth, now distant indeed. Several times during that long trip he was sorely tempted to call Haynes through his Lens and get things started; but he always thought better of it. This was altogether too important a thing to be sent through so much sub-ether, or even to be thought about except inside an absolutely thought-tight room. And besides, every waking hour of even that long trip could be spent very profitably in digesting and correlating the information he had obtained and in mapping out the salient features of the campaign that was to come. Therefore, before time began to drag, Kinnison landed at Prime Base and was granted instant audience with Port Admiral Haynes.

"Mighty glad to see you, son," Haynes greeted the young Lensman cordially, as he sealed the room thought-tight. "Since you came in under your own power, I assume that you are here to make a constructive report?"

"Better than that, sir. I'm here to start something in a big way. I know at last where their Grand Base is, and have detailed plans of it. I think that I know who and where Boskone is. I know where Helmuth is, and I have worked out a plan whereby, if it works, we can wipe out that base, Boskone, Helmuth, and all the lesser master minds, at one wipe."

"Holy jumping rockets!" For the first time since Kinnison had known him the old man lost his poise. He leaped to his feet and seized Kinnison by the arm. "I knew you were good, but not *that* good! The Arisians gave you the treatments you wanted, then?"

"They sure did," and the younger man reported as briefly as possible everything that had happened, then outlined the plan upon which he had been working so long.

"I am just as sure that Helmuth is Boskone as I can be of anything that can't be proved," Kinnison declared, bending over a huge chart and sketching rapidly. "Helmuth speaks for Boskone, and nobody else ever does, not even Boskone himself. None of the other big shots know anything about Boskone or ever heard him speak; but they all jump through their hoops when Helmuth, 'speaking for Boskone,' cracks the whip. And I couldn't get a trace of Helmuth ever taking anything up with any higher-ups. Therefore, I am dead certain that when we get Helmuth we get Boskone.

"BUT that's going to be a real job of work. I scouted his headquarters from stem to gudgeon, as I told you; and Grand Base is absolutely impregnable as it stands. I never imagined anything like it. It makes Prime Base here look like a deserted cross roads after a hard winter. They've got screens, pits, projectors, accumulators, all on a gigantic scale. In fact, they've got everything. But you can get all that from the tape. I have learned definitely that we cannot take them by any possible direct frontal attack. Even if we attacked with every ship and mauler we've got throughout the galaxy they could stand us off. And they can match us, ship for ship. We'd never get near that base at all if they knew that we were coming."

"Well, if it's such an impossible job, what——"

"I'm coming to that. It is impossible as it stands; but there's a good chance that I'll be able to soften Grand Base up. You know, like a worm—bore from within. Anyway, that's the only possible way to do it, so I've got to try it. You'll have to put detector nullifiers on every ship assigned to the job, but that'll be easy. I would suggest sending all the maulers and first-class

battleships we've got, but you will, of course, work that out later."

"The important thing, as I gather it, is timing."

"Absolutely to the minute, since I won't be able to communicate, once I get inside their thought screens. How long will it take to concentrate everything we've got and put it in that cluster?"

"Seven weeks—eight at the outside."

"Plus two for allowances. QX. At exactly Hour 20, ten weeks from today, let every projector of every vessel that you can possibly get there cut loose on that base with everything they can pour in. Where's that other print? Here—twenty-six main objectives, you see. Blast them all, simultaneously to the second. If they all go down, the rest will be possible. If not, it will be just too bad. Then work along these lines here, straight from those twenty-six stations to the dome, blasting everything as you go. Make it last exactly fifteen minutes, not a minute more or less. If, by fifteen minutes after twenty, the main dome hasn't surrendered by cutting its screens, blast that, too, if you can. It'll take a lot of blasting, I'm afraid. From then on you and the fleet commander will have to do whatever is appropriate to the occasion."

"Your plan doesn't cover that, apparently. Where will you be? How will *you* be fixed—if the main dome does not cut its screens?"

"I'll be dead, and you'll be just starting the damnedest war that this galaxy ever saw."

XXIII.

WHILE servicing and checking over the speedster required only a couple of hours, Kinnison did not leave Earth for almost two days. He had requisitioned much special equipment, the construction of one item of which—a suit of armor such as had never been seen upon Earth before—caused almost all of the delay. When it was ready the greatly interested port admiral accompanied the young Lensman out to the steel-lined, sand-filled concrete dugout, in which the suit had already been mounted upon a remote-controlled dummy. Fifty feet from that dummy there was a heavy, water-cooled machine rifle, with its armored crew standing by. As the two approached the crew leaped to attention.

"As you were," Haynes instructed.

"You checked those cartridges against those I brought in from Aldebaran I?" asked Kinnison of the officer in charge, as, accompanied by the port admiral, he crouched down behind the shields of the control panel.

"Yes, sir. These are twenty-five per cent over, as you specified."

"QX—commence firing!" Then, as the weapon clamored out its stuttering, barking roar, Kinnison made the dummy stoop, turn, bend, twist, and dodge, so as to bring its every plate, joint, and member into the hail of steel. The uproar stopped.

"One thousand rounds, sir," the officer reported.

"No holes—no dents—not a scratch or a scar," Kinnison reported, after a minute examination, and got into the thing. "Now give me two thousand rounds, unless I tell you to stop. Shoot!"

Again the machine rifle burst into its ear-shattering song of hate; and, strong as Kinnison was and powerfully braced by the blast of his drivers, he could not stand against the awful force of those bullets. Over he went, backward, and the firing ceased.

"Keep it up!" he snapped. "Think they're going to quit shooting at me because I fall down?"

"But you had had nineteen hundred!" protested the officer.

"Keep on pecking until you run out of ammunition or until I tell you to stop," ordered Kinnison. "I've got to learn how to handle this thing under fire." The storm of metal again began

to crash against the reverberating shell of steel.

It hurled the Lensman down, rolled him over and over, slammed him against the backstop. Again and again he struggled upright, only to be hurled again to ground as the riflemen, really playing the game now, swung their leaden hail from part to part of the armor, and varied their attack from steady fire to short, but savage, bursts. But finally, in spite of everything the gun crew could do, Kinnison learned his controls.

THEN, drivers flaring, he faced that howling, chattering muzzle and strode straight into the stream of smoke- and flame-enshrouded steel. Now the air was literally full of metal. Bullets and fragments of bullets whined and shrieked in mad abandon as they ricocheted off that armor in all directions. Sand and bits of concrete flew hither and yon, filling the atmosphere of the dugout. The rifle yammered at maximum, with its sweating crew laboring mightily to keep its voracious maw full-fed. But, in spite of everything, Kinnison held his line and advanced. He was a bare ten feet from that raving, steel-vomiting muzzle when the firing again ceased.

"Twenty thousand, sir," the officer reported, crisply. "We'll have to change barrels before we can give you any more."

"That's enough!" snapped Haynes. "Come out of there!"

Out Kinnison came. He removed heavy ear plugs, swallowed four times, blinked and grimaced. Finally he spoke. "It works perfectly, sir, except for the noise. It's a good thing I've got a Lens. Even though I was wearing plugs, I won't be able to hear a sound for three days!"

"How about the springs and shock absorbers? Are you bruised anywhere? You took some real bumps."

"Perfect—not a bruise. Let's look her over."

Every inch of that armor's surface was now marked by blurs, where the metal of the bullets had rubbed on the shining alloy, but that surface was neither scratched, scored, nor dented.

"QX, boys—thanks," Kinnison dismissed the riflemen. They probably wondered how any man could see through a helmet built up of inches-thick laminated alloys, with neither window nor port through which to look; but if so, they made no mention of their curiosity. They, too, were patrolmen.

"Is that thing an armor or a personal tank?" asked Haynes. "I aged ten years while that was going on; but, at that, I'm glad you insisted on testing it as you did. You can get away with anything now."

"I've found that it is much better technique to learn things among friends here, than among enemies." Kinnison laughed. "It's heavy, of course—over three hundred kilos, net. I won't be walking around in it much, though; and even that little I'll be flying it instead of walking it. Well, sir, since everything's all set, I think I'd better fly it over to the speedster and start flitting, don't you? I don't know exactly how much time I am going to need on Trenco."

"Might as well," the port admiral agreed, as casually, and Kinnison was gone.

"What a man!" Haynes stared after the monstrous figure until it vanished in the distance, then strolled slowly toward his office, thinking as he went.

NURSE MacDOUGALL had been highly irked and incensed at Kinnison's casual departure, without idle conversation or formal leave takings. Not so Haynes. That seasoned campaigner knew that gray Lensmen—particularly young gray Lensmen—were prone to get that way. He knew, in a way she never would and never could know, that Kinnison was no longer of Earth.

He was now only of the galaxy, not

of any one tiny dust grain of it. He was of the patrol. He *was* the patrol, and he was taking his new responsibilities very seriously indeed. In his fierce zeal to drive his campaign through to a successful end he would use man or woman, singly or in groups, ships, even Prime Base itself, exactly as he had used them: as pawns, as mere tools, as means to an end. And, having used them, he would leave them as unconcernedly and as unceremoniously as he would drop pliers and spanner, and with no realization that he had violated any of the nicer amenities of life as it is lived!

And as he strolled along and thought, the port admiral smiled quietly to himself. He knew, as Kinnison would learn in time, that the universe was vast, that time was long, and that the Scheme of Things, comprising the whole of eternity and the cosmic all, was a something incomprehensibly immense indeed. With which cryptic thought the space-hardened veteran sat down at his desk and resumed his interrupted labors.

But Kinnison had not yet attained Haynes' philosophic viewpoint, any more than he had his age, and to him the trip to Trenco seemed positively interminable. Eager as he was to put his plan of campaign to the test, he found that mental urgings, or even audible invectives, would not make the speedster go any faster than the already incomprehensible top speed of her drivers' maximum blast. Nor did pacing up and down the little control room seem to help very much. Physical exercise he had to perform, but it did not satisfy him. Mental exercise was impossible; he could think of nothing except Helmuth's base.

EVENTUALLY, however, he approached Trenco and located, without difficulty, the patrol's space port. Fortunately, it was then at about eleven o'clock, so that he did not have to wait long to land. He drove downward inert, sending a thought ahead of him: "Lensman of Trenco Space Port—Tregonsee or his relief? Lensman Kinnison of Sol III asking permission to land."

"It is Tregonsee," came back the thought. "Welcome, Kinnison. You are on the correct line. You have, then, perfected an apparatus to see truly in this distorting medium?"

"I didn't perfect it—it was given to me."

The landing bars lashed out, seized the speedster, and eased her down into the lock; and, as soon as she had been disinfected, Kinnison went into consultation with Tregonsee. The Rigellian was a highly important factor in the Tellurian's scheme; and, since he was also a Lensman, he was to be trusted implicitly.

Therefore, Kinnison told him briefly what occurred and what he had it in mind to do, concluding: "So you see, I need about fifty kilograms of thionite. Not fifty milligrams, or even grams, but fifty *kilograms;* and, since there probably isn't that much of the stuff loose in the whole galaxy, I came over here to ask you to make it for me."

Just like that. Calmly asking a Lensman, whose sworn duty it was to kill any being even attempting to gather a single Trenconian plant, to make for him more of the prohibited drug than was ordinarily processed throughout the galaxy during a solarian month! It would be just such an errand were one to walk into the treasury department in Washington and inform the chief of the narcotics bureau, quite nonchalantly, that he had dropped in to pick up ten tons of heroin! But Tregonsee did not flinch or question—he was not even surprised. This was a gray Lensman, and his plan would work.

"That should not be too difficult," Tregonsee replied, after a moment's study. "We have several thionite processing units, confiscated from zwilnik ships and not yet picked up by head-

quarters; and all of us are, of course, quite familiar with the technique of extracting and purifying the drug."

He issued orders and shortly Trenco Space Port presented the astounding spectacle of a full crew of the Galactic Patrol devoting its every energy to the whole-hearted breaking of the one law it was supposed most rigidly, and without fear or favor, to enforce!

IT WAS a little after noon, the calmest hour of Trenco's day. The wind had died to "nothing"; which, on that planet, meant that a strong man could stand against it; could even, if he were agile as well as strong, walk about in it. Therefore, Kinnison donned his light armor and was soon busily harvesting the purple-leaved plants, which, he had been informed, were the richest sources of thionite.

He had been working for only a few minutes when one of the "natives" came crawling up to him; and, after ascertaining that his hard steel armor was not good to eat, drew off and observed him intently. Here was another opportunity for practice, and in a flash the Lensman availed himself of it. Having practiced for hours upon the minds of various Earthly animals, he entered this mind easily enough, finding that the Trenconian "flat" was considerably more intelligent than a dog. So much so, in fact, that the race had already developed a fairly comprehensive language.

Therefore, it did not take long for the Lensman to learn to use his subject's peculiar limbs and other members, and soon the flat was working like a Trojan. And, since he was ideally adapted for his wildly raging Trenconian environment, he actually accomplished more than all the rest of the force combined.

"It's a dirty trick I'm playing on you, fellow," Kinnison told his helper after a while. "Come on into the receiving room and I'll see if I can square it with you."

Since food was the only logical tender, Kinnison brought out from his speedster a small can of salmon, a package of cheese, a bar of chocolate, a few lumps of sugar, and a potato, offering them to the Trenconian in order. The salmon and the cheese were both highly acceptable fare. The morsel of chocolate was a delightfully surprising delicacy. The lump of sugar, however, was what really rang the bell. Kinnison's own mind felt the shock of pure ecstasy as that wonderful substance dissolved in the trenco's mouth. He also ate the potato, of course —any Trenconian animal will, at any time, eat anything containing carbon, even limerock, gasoline, or truck grease —but it was merely food, nothing to rave about.

Knowing now what to do, Kinnison led his assistant out into the howling, shrieking gale and released him from control, throwing a lump of sugar upwind as he did so. The trenco seized it in the air, ate it, and went into a very hysteria of joy.

"More! More!" he insisted, attempting to climb up the Lensman's armored leg.

"You must work for more of it, if you want it," Kinnison explained. "Break off these plants here and carry them over into that empty thing over there, and you get more."

This was an entirely new idea to the native, but after Kinnison had taken hold of his mind and had shown him how to do consciously that which he had been doing unconsciously for an hour, he worked willingly enough. In fact, before it started to rain, thereby putting an end to the labor of the day, there were a dozen of them toiling at the harvest and the crop was coming in as fast as the entire crew of Rigellians could process it. And even after the space port was sealed they crowded up,

paying no attention to the rain, bringing in their small loads of leaves and plaintively asking admittance.

IT TOOK some little time for Kinnison to make them understand that the day's work was done, but that they were to come back to-morrow morning. Finally, however, he succeeded in getting the idea across, and the last disconsolate turtle-man went reluctantly away. But sure enough, next morning, even before the mud had dried, the same twelve were back on the job. The two Lensmen wondered simultaneously how those trencos could have found the space port. Or had they stayed near it through the storm and flood of the night?

"I don't know," Kinnison answered the unasked question, "but I can find out." Again and more carefully he examined the minds of two or three of them. "No, they didn't follow us," he reported then. "They're not as dumb as I thought they were. They have a sense of perception, Tregonsee, about the same thing, I judge, as yours—perhaps even more so. I wonder—why couldn't they be trained into mighty efficient police assistants on this planet?"

"The way *you* handle them, yes. I can converse with them a little, of course, but they have never before shown any willingness to coöperate with us."

"You never fed them sugar." Kinnison laughed. "You have sugar, of course—or do you? I was forgetting that many races do not use it at all."

"We Rigellians are one of those races. Starch is so much tastier and so much better adapted to our body chemistry that sugar is used only as a chemical. We can, however, obtain it easily enough. But there is something else. You can tell these trencos what to do and make them really understand you. I cannot."

"I can fix that up with a simple mental treatment that I can give you in five minutes. Also, I can let you have enough sugar to carry on with until you can get in a supply of your own."

In the few minutes during which the Lensmen had been discussing their potential allies, the mud had dried and the amazing coverage of dense, succulent "grass" was springing visibly into being. So incredibly rapid was its growth that in ten minutes more the plants were large enough to be gathered. The leaves were lush and rank, in color a vivid, crimsonish purple.

"These early-morning plants are the richest of any in thionite, but the zwilniks can never get more than a handful of them because of the wind," remarked the Rigellian. "Now, if you will give me that treatment, I will see what I can do with the Flats."

Kinnison did so, and the trencos worked for Tregonsee as industriously as they had for Kinnison—and ate his sugar as rapturously.

"That is enough," decided the Rigellian presently. "This will finish your fifty kilograms and to spare."

He then "paid off" his now enthusiastic helpers, with instructions to return when the sun was directly overhead, for more work and more sugar. And this time they did not complain, nor did they loiter around or bring in unwanted vegetation. They were learning fast.

Well before noon the last kilogram of impalpable, purplish-blue powder was put into its impermeable sack. The machinery was cleaned; the untouched leaves, the waste, and the contaminated air were blown out of the space port; and the room and its occupants were sprayed with anti-thionite. Then and only then did the crew remove their masks and air filters. Trenco Space Port was again a patrol post, no longer a zwilnik's paradise.

"Thanks, Tregonsee, and all you fellows——" Kinnison paused, then went on, dubiously, "I don't suppose that you will——"

"We will not," declared Tregonsee. "Our time is yours, as you know, without payment; and time is all that we gave you, really."

"Sure—that and about a thousand million credits' worth of thionite."

"That, of course, does not count, as you also know. You have helped us, I think, even more than we have helped you."

"I hope that I have done you some good, anyway. Well, I've got to flit. Thanks again. I'll see you sometime, maybe." And again the Tellurian Lensman was on his way.

XXIV.

KINNISON approached Star Cluster AC 257-4736 warily, as before; and as before he insinuated his speedster through the loose outer cordon of guardian fortresses. This time, however, he did not steer even remotely near Helmuth's world. He would be there too long; there was altogether too much risk of electromagnetic detection to set his ship into any kind of an orbit around *that* planet. Instead, he had computed a long, narrow, elliptical orbit around its sun, well inside the zone guarded by the maulers. He could compute it only approximately, of course, since he did not know exactly either the masses involved or the perturbing forces; but he thought that he could find his ship again with an electro. If not, she would not be an irreplaceable loss. He set the speedster, then, into the outward leg of that orbit and took off in his new armor.

He knew that there was a thought-screen around Helmuth's planet, and suspected that there might be other screens as well. Therefore, shutting off every watt of power, he dropped straight down into the night side, well clear of the citadel's edge. His flares were, of course, heavily baffled; but even so he did not put on his brakes until it was absolutely necessary. He landed heavily, then sprang away in long, free hops, until he reached his previously selected destination: a great cavern thickly shielded with iron ore and fully five thousand miles from his point of descent. Deep within that cavern he hid himself, then searched intently for any sign that his approach had been observed. There was no such sign. So far, so good.

But during his search he had perceived with a slight shock that Helmuth had tightened his defenses even more. Not only was every man in the dome screened against thought, but also each was now wearing full armor. Had he protected the dogs, too? Or killed them? No real matter if he had—any kind of a pet animal would do; or, in a pinch, even a wild rock-lizard! Nevertheless, he shot his perception into the particular barracks he had noted so long before, and found with some relief that the dogs were still there, and that they were still unprotected. It had not occurred, even to Helmuth's cautious mind, that a dog could be a source of mental danger.

With all due precaution against getting even a single grain of the stuff into his own system, Kinnison transferred his thionite into the special container in which it was to be used. Another day sufficed to observe and to memorize the personnel of the gateway observers, their positions, and the sequence in which they took the boards. Then the Lensman, still almost a week ahead of schedule, settled down to await the time when he should make his next move. Nor was this waiting unduly irksome; now that everything was ready he could be as patient as a cat on duty at a mouse hole.

THE TIME came to act. Kinnison took over the mind of the dog, which at once moved over to the bunk in which one particular observer lay asleep. There would be no chance whatever of

gaining control of any observer while he was actually on the board, but here in barracks it was almost ridiculously easy. The dog crept along on soundless paws; a long, slim nose reached out and up; sharp teeth closed delicately upon a battery lead; out came the plug. The thought screen went down, and instantly Kinnison was in charge of the fellow's mind.

And when that observer went on duty his first act was to admit Kimball Kinnison, gray Lensman, to the Grand Base of Boskone! Low and fast Kinnison flew, while the observer so placed his body as to shield from any chance passer-by the all-too-revealing surface of his visiplate. In a few minutes the Lensman reached a portal of the dome itself. Those doors also opened—and closed behind him. He released the mind of the observer and watched briefly. Nothing happened. All was still well!

Then, in every barracks save one, using whatever came to hand in the way of dog or other unshielded animal, Kinnison wrought briefly but effectively. He did not slay by mental force—he did not have enough of that to spare—but the mere turn of an inconspicuous valve would do just as well. Some of those now idle men would probably live to answer Helmuth's call to extra duty, but not too many—nor would those who obeyed that summons live long thereafter.

Down stairway after stairway he dived, down to the compartment in which was housed the great air purifier. Now let them come! Even if they had a spy ray on him, now it would be too late to do them a bit of good. And now, by all the gods of space, that fleet had better be out there, getting ready to blast!

It was. From all over the galaxy that grand fleet had been assembled; every patrol base had been stripped of almost everything mobile that could throw a beam. Every vessel carried either a Lensman or some other highly trusted officer; and each such officer had two detector nullifiers—one upon his person, the other in his locker—either one of which would protect his whole ship from detection.

In long lines, singly and at intervals, those untold thousands of ships had crept between the vessels guarding Grand Base. Nor were the outpost crews to blame. They had been on duty for months, and not even an asteroid had relieved the monotony. Nothing had happened or would. They watched their plates steadily enough—and, if they did nothing more, why should they? And what could they have done? How could they suspect that such a thing as a detector nullifier had been invented?

THE patrol's grand fleet, then, was already massing over its primary objectives, each vessel in a rigidly assigned position. The pilots, captains, and navigators were chatting among themselves jerkily and in low tones, as though even to raise their voices might reveal prematurely to the enemy the concentration of the patrol forces. The firing officers were already at their boards, eyeing hungrily the small switches which they could not throw for so many long minutes yet.

And far below, beside the pirates' air purifier, Kinnison released the locking toggles of his armor and leaped out. To burn a hole in the primary duct took only a second. To drop into that duct his container of thionite, to drench that container with the reagent which would in sixty seconds dissolve completely that container's substance without affecting either its contents or the metal of the duct, to slap a flexible adhesive patch over the hole in the duct, and to leap back into his armor—all these things required only a trifle over one minute. Eleven minutes to go—QX.

Then in the last barracks, even while

the Lensman was arrowing up the stairways, a dog again deprived a sleeping man of his thought screen. That man, however, instead of going to work, took up a pair of pliers and proceeded to cut the battery leads of every sleeper in the barracks, severing them so close that no connection could be made without removing the armor.

As those leads were severed men woke up and dashed into the dome. Along catwalk after catwalk they raced, and apparently that was all that they were doing. But each runner, as he passed a man on duty, flicked a battery plug out of its socket; and that observer, at Kinnison's command, opened the face plate of his armor and breathed deeply of the now drug-laden atmosphere.

Thionite, as has been intimated, is perhaps the worst of all known habit-forming drugs. In almost infinitesimal doses it gives rise to a state in which the victim seems actually to experience the gratification of his every desire, whatever that desire may be. The larger the dose, the more intense the sensation, until—and very quickly—the dosage is reached at which he passes into such an ecstatic stupor that not a single nerve can force a stimulus into his frenzied brain. In this stage he dies.

Thus there was no alarm, no outcry, no warning. Each observer sat or stood entranced, holding exactly the pose he had been in at the instant of opening his face plate. But now, instead of paying attention to his duty, he was plunging deeper and deeper into the paroxysmally ecstatic profundity of a thionite debauch from which there was to be no awakening. Therefore, half of that mighty dome was unmanned before Helmuth even realized that anything at all out of order was going on.

As soon as he realized that something was amiss, however, he sounded the "all-hands-on-duty" alarm and rapped out instructions to the officers in the barracks. But the cloud of death had arrived there first, and to his consternation not one quarter of those officers responded. Quite a number of men did get into the dome, but every one of them collapsed before reaching the catwalks. And three fourths of his working force were *hors de combat* before he located Kinnison's speeding messengers.

"Blast them down!" Helmuth shrieked, pointing, gesticulating madly.

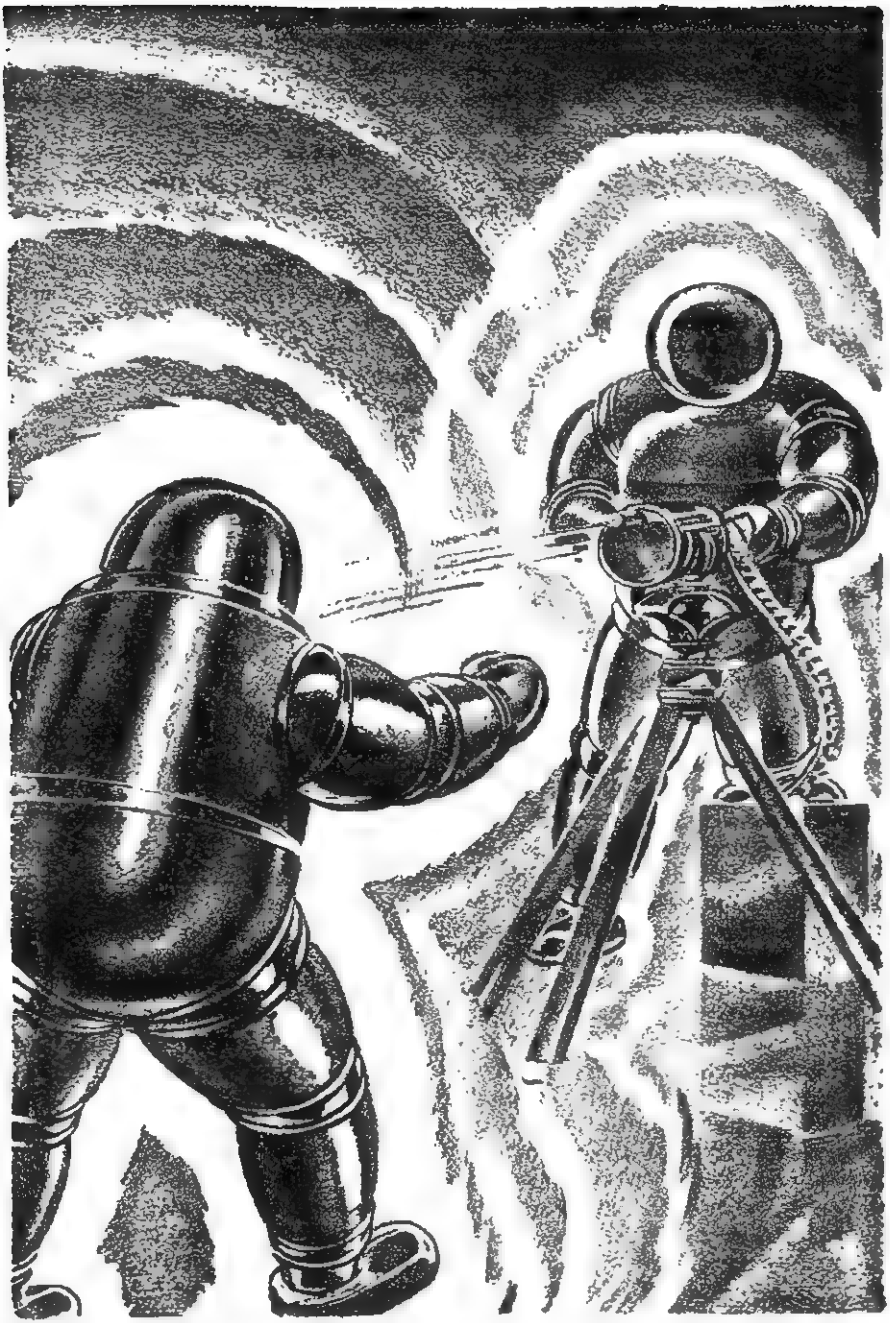
Blast whom down? The minions of the Lensman were themselves blasting away now, right and left, shouting contradictory but supposedly authoritative orders.

"Blast those men not on duty!" Helmuth's raging voice now filled the dome. "You, at Board 479! Blast that man on Catwalk 28, at Board 495!"

With such detailed instructions, Kinnison's agents, one by one, ceased to be But as one was beamed down another took his place, and soon every one of the few remaining living pirates in the dome was blasting indiscriminately at every other one. And ,then, to cap the Saturnalian climax, came the zero second.

THE GRAND FLEET of the Galactic Patrol had assembled. Every cruiser, every battleship, every mauler hung poised above its assigned target. Every vessel was stripped for action. Every accumulator cell was full to its ultimate watt; every generator and every arm was tuned and peaked to its highest attainable efficiency. Every firing officer upon every ship sat tensely at his board, his hand hovering near, but not touching, his firing keys, his eyes fixed glaringly upon the second hand of his synchronized electric timer, his ears scarcely hearing the droning, soothing voice of Port Admiral Haynes.

For the old man had insisted upon giving the firing order himself, and he now sat at the master timer, speaking



But Helmuth could not now reach that ball of force—and Kinnison's mighty armor forged undamaged through the hail of metal.

into the master microphone. Beside him sat von Hohendorff, the grand old commandant of cadets. Both of these veterans had thought long since that they were done with space war forever; but only an order of the full Galactic Council could have kept either of them at home. They were grimly determined that they were going to be in at the death, even though they were not at all certain whose death it was to be. If it should turn out that it was to be Helmuth's, all well and good—everything would be on the green. If, on the other hand, young Kinnison had to go, they would; in all probability, have to go, too—and so be it.

"Now remember, boys, keep your hands off those keys until I give you the word," Haynes' soothing voice droned on, giving no hint of the terrific strain he himself was under. "I'll give you lots of warning. I am going to count the last five seconds for you. I know that you all want to shoot the first bolt, but remember that I, personally, will strangle any and every one of you who beats my signal by a thousandth of a second. It won't be long now; the second hand is starting around on its last lap. Keep your hands off those keys. Keep away from them, I tell you, or I'll smack you down. Fifteen seconds yet. Stay away, boys; let 'em alone. Going to start counting now." His voice dropped lower and lower. "Five—four—three—two—one—*fire!*" he yelled.

Perhaps some of the boys did beat the gun a trifle; but not many, or much. To all intents and purposes it was one simultaneous blast of destruction that flashed down from a hundred thousand projectors, each delivering the maximum blast of which it was capable. There was no thought now of service life, of equipment or of holding anything back for a later effort. They had to hold that blast for only fifteen minutes; and if the task ahead of them could not be done in those fifteen minutes it probably could not be done at all.

Therefore, it is entirely useless even to attempt to describe what happened then, or to portray the spectacle that ensued when beam met screen. Why try to describe high C to a man born deaf? Suffice it to say that those patrol beams bored down, and that Helmuth's automatic screens resisted to the limit of their ability. Nor was that resistance small. It was of such power that, years later, astronomers observed and recorded a peculiarly behaving Nova in Star Cluster AC 257-4736.

Had Helmuth's customary staff of keen-eyed, quick-witted lieutenants been at their posts, to reënforce those primary screens with the practically unlimited power which could have been put behind them, his defenses would not have failed, even under the unimaginable force of that Titanic thrust; but those lieutenants were not at their posts. The screens of the twenty-six primary objectives failed, and the twenty-six stupendous flotillas moved slowly, grandly, voraciously, each along its designated line.

EVERY ALARM in Helmuth's dome had burst into frantic warning as the massed might of the Galactic Patrol was first hurled against the twenty-six vital points of Grand Base; but those alarms clamored in vain. No hands were raised to the switches whose closing would unleash the hellish energies of Boskone's irresistible projectors; no eyes were upon the sighting devices which would align them against the attacking ships of war.

Only Helmuth, in his inner-shielded control compartment, was left; and Helmuth was the directing intelligence, the master mind, and not a mere operator. And, now that he had no operators to direct, he was utterly helpless. He could see the stupendous fleet of the patrol; he could understand fully its dire men-

ace; but he could neither stiffen his screens nor energize a single beam. He could only sit, grinding his teeth in helpless fury, and watch the destruction of the armament which, if it could only have been in operation, would have blasted those battleships and maulers from the skies as though they had been so many fluffy bits of thistledown.

Time after time he leaped to his feet, as if about to dash across to one of the control stations; but each time he sank back into his seat at the desk. One firing station would be little, if any, better than none at all. Besides, that accursed Lensman was back of this. He was—must be—right here in the dome, somewhere. He *wanted* him to leave this desk; that was what he was waiting for! As long as he stayed at the desk he himself was safe. For that matter, this whole dome was safe. The projector had never been mounted that could break down *those* screens. No—no matter what happened, he would stay at the desk!

Kinnison, watching, marveled at his fortitude. He himself could not have stayed there, he knew; and he also knew now that Helmuth was going to stay. Time was flying; five of the fifteen minutes were gone. He had hoped that Helmuth would leave that well-protected inner sanctum, with its unknown potentialities; but if the pirate would not come out, the Lensman would go in. The storming of that inner stronghold was what his new armor had been designed for.

IN HE WENT, but he did not catch Helmuth napping. Even before he crashed the screens his own defensive zones burst into furiously coruscant activity, and through that flame there came tearing the metallic slugs of a high-caliber machine rifle.

Ha! There *was* a rifle, even though he had not been able to find it! Clever guy, that Helmuth! And what a break that he had taken time to learn how to hold this suit up against the trickiest kind of machine-rifle fire!

Kinnison's screens were almost those of a battleship; his armor almost, relatively, as strong. And he could hold that armor upright. Therefore, through the raging beam of the semiportable projector he plowed, and straight up that torrent of raging steel he drove his way. And now from his own mighty projector, against Helmuth's armor, there raved out a beam scarcely less potent than that of a semiportable. The Lensman's armor did not mount a water-cooled machine rifle—there was a limit to what even that powerful structure could carry—but grimly, with every faculty of his newly enlarged mind concentrated upon that thought-screened, armored head behind the belching gun, Kinnison held his line and forged ahead.

Well it was that the Lensman *was* concentrating upon that screened head; for when the screen weakened slightly and a thought began to seep through it toward an enigmatically sparkling ball of force, Kinnison was ready. He blanketed the thought savagely, before it could take form, and attacked the screen so viciously that Helmuth had either to restore full coverage instantly or die then and there. For the Lensman had studied that ball long and earnestly. It was the one thing about the whole base that he could not understand, the one thing, therefore, of which he had been uneasily afraid.

But he was afraid of it no longer. It was operated, he now knew, by thought; and, no matter how terrific its potentialities might be, it now was and would remain perfectly harmless; for if the pirate chief softened his screen enough to emit a thought, he would never think again.

Therefore, Kinnison rushed. At full blast he hurdled the rifle and crashed

full against the armored figure behind it. Magnetic clamps locked and held; and, driving projectors furiously ablaze, he whirled around and forced the madly struggling Helmuth back, toward the line along which the bellowing rifle was still spewing forth a continuous storm of metal.

Helmuth's utmost efforts sufficed only to throw the Lensman out of balance, and both figures crashed to the floor. Now the madly fighting armored pair rolled over and over—straight into the line of fire.

First Kinnison—the bullets whining, shrieking off the armor of his personal battleship and crashing through or smashing ringingly against whatever happened to be in the ever-changing line of ricochet. Then Helmuth—and the fierce-driven metal slugs tore, in their multitudes, through his armor and through his body, riddling his every vital organ.

MERCURY

I know from your letters in Brass Tacks how closely you watch every item of the magazine: I think that most of you must have noticed our *mutant* cover at once. Noticed it as different—but it does not on the face of it show the work and planning that have gone into its making.

That cover is the first of a series—a new *mutant* field opened to science-fiction. It illustrates Raymond Z. Gallun's story "Mercutian Adventure", but more than that; it is an accurate astronomical color-plate. You noticed there was no text, no printed matter on the picture itself? There will be none on the astronomical plates to follow. Each will be, as is this, as accurate a representation of some other-world scene as modern astronomical knowledge and the complex psychology and physics of human vision make possible.

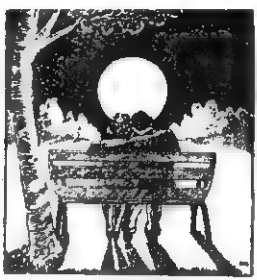
Psychology and astronomy? Certainly! Howard Brown and I worked over this cover, I trying to get the astronomy accurate; Brown, helping in the more difficult work of interpretation of fact to human understanding. The flat plain of sun-gilded dust—Gallun's right you know; the plains of Mercury must be made of pumice-like rock-dust spauled off by the fierce heat of the sun—the craggy mountain range—those are accurate interpretations of modern knowledge. But the Sun? It's much too large, really.

Yet the basic feature—the mutation of science-fiction's evolution Astounding is offering—is astronomical accuracy of proportion, the sublimation of an illustration to an astronomical text-book quality color-plate.

But that is where Brown's knowledge of the psychology and mechanism of human vision played its part. If he had painted that Sun as it would appear to a camera or to observing instruments there on Mercury—the color-plate would not have given an accurate representation of *what you would see if you were there.* Human vision is not purely a physical process; it involves physics, but is subjected to the modifying effect of psychology. You know how a camera seems to distort the appearance of a hallway, or the interior of a passage? The camera *does not*—but your eyes do!

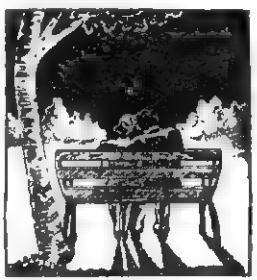
How large does the Moon look? Asked that, most people ask, "Do you mean when it's rising, or when it's well up in the sky?" Because human vision tricks you, for it is actually the same in both instances. Look at the two little cuts below: One seems right, a typical "Lovers' Moon". The other seems distorted—*because it's in correct proportion!*

Brown has off-set that human failing of the eyes. The Sun is disproportionately large, but accurately disproportionate. And as in this first, *mutant* cover, so in all of the series to come, our astronomical color-plate covers will be as accurate an impression as astronomical science and knowledge of human reaction can make them.



That is our first mutation—the first use of a science-fiction cover as an astronomical plate. I want you to tell me now—in both Science Discussions and Brass Tacks—what you think of it, and what further studies you believe would merit such attention.

The Editor.



Astounding effect of science on a "Lovers' Moon"—the correct size is shown by a quarter at a distance of ten feet.

Mercutian Adventure

By

Raymond Z. Gallun

The story on which our MUTANT cover is based—two humans against an inhospitable world.

EVERYTHING'S going to turn out fine, Lois," Jess Chandon had said to his young bride. "I've read up on Mercury, and it's a swell place for a couple of people to make money! Scientists have talked a lot about that world not being worth a darn—but I've got an idea!

"Those mountains of Mercury, those blazing and almost airless deserts, those funny plants in the Twilight Belt, those cold stars of the night hemisphere! There's romance in all that stuff, darling! Everybody likes the glamour of far-off places, even though they can't see them first-hand. That's where we come in. We're going to take pictures on Mercury—artistic pictures portraying the mood of that grim little planet—and we're going to bring them back to Earth and sell them to syndicates!"

Jess Chandon had been full of youthful enthusiasm. He was only twenty-two at the outset. And Lois, three years younger, had responded to his feelings with eager hope, behind which was a lust for adventure which was no less compelling than her husband's. For Lois Parker Chandon was a tomboy at heart.

"There's competition, of course," she had said. "I've seen Mercury-pictures before. But I didn't think any of them were very good. We can do a lot better. I'm with you, Jess—all the way—even if it takes our last cent!"

They'd bought a small and ancient spaceboat with the few thousand dollars they had between them. Once the ship had been named *The Pegasus;* long since it had lost much of the quality that had made that name appropriate. More appropriately they had rechristened it—*Old Grouchy.*

Old Grouchy hadn't failed them in its greatest test. It had taken them from Earth—across the orbit of Venus—to Mercury, which hurtles in its eccentric path at a mean distance of only 36,000,000 miles from the Sun.

On Mercury the Chandons had one week—Earth-time—of what seemed to them great success. Their cameras captured in form and color the lonely, empty grandeur of scenes which few had bothered to photograph before. In their eagerness they failed to realize the minimizing effect of human indifference. Pictures are just pictures—no matter how intriguing their source may be.

The Twilight Belt—the region of alternating dusk and dawn occasioned by the planet's librating wabble, which is its only substitute for effective rotation—was naturally the site of the Chandons' greatest activity, but they ventured into the utterly frozen night-region, too. And once, for a brief hour, they dared the terrific heat of the hemisphere of eternal day.

Eardrums ached—hearts raced as they felt air bubble from their lungs into the vacuum about——

IT WAS after this adventure that their luck assumed a really malignant twist. They landed *Old Grouchy* in a deep valley of the Twilight Belt that they might repair their spacesuits. The latter had been damaged by the awful solar glare that bathed the red-hot rocks of Mercury's sunward face eternally.

The job in hand was a slow and tedious one. It was necessary to take the spacesuits completely apart at the seams, scrape off the caked and hardened seal-

ing material, and replace it with fresh composition.

And—everything was a useless litter when Lois frowned in puzzlement, straining her ears to capture what seemed an ominous noise.

"Do you hear that, Jess?" she demanded sharply.

For a moment he listened, too. Then he nodded. The sound was a faint, bubbling rumble. It came, obviously, from the aft portion of the spaceboat. Jess Chandon couldn't interpret its meaning at first; then his eyes widened in fearful comprehension.

"Lord!" he gasped. Then he swallowed painfully. "We've got to get out of this ship right away—and we haven't any spacesuits! There's almost no air out there, and it's colder than blazes! What are we gonna do?"

They were both on their feet now, Lois wondering what it was all about, and Jess wondering how they could keep on living for even ten minutes longer!

"That noise," he said miserably, "is in the fuel tanks."

Further explanation was unnecessary. The girl had by now acquired a considerable knowledge of spaceships and how their various mechanisms work. Rocket fuel is a metal called "dynamium," which, like gallium and mercury metals, is liquid at common Earthly temperatures. But it is very heavy, being artificially built up from lesser elements by a process of transmutation. Its atoms, far more complex even than those of radium and uranium, do not occur naturally anywhere. They are extremely unstable, breaking down with tremendous explosive violence under a slight electrical stimulus.

In seven or eight minutes, as soon as the disruptive processes started in the dynamium had gained sufficient momentum, *Old Grouchy's* fuel tanks were going to explode! An attempt to drain them would accomplish no good; it would only serve to flood the ship with poisonous radioactive gases.

Lois Chandon understood. "There must be a leak in our spaceboat's insulation," she said dully. "The Sun's electrical emanations must have got through it when we were on the daylight hemisphere, stirring up the fuel."

SHE LOOKED almost in unbelief at the scattered pieces of the spacesuits, a thousand emotions vibrating through her slender body. Confronted by the grim fact, true realization of their position had come to her. Her brown eyes were cool when she looked up at her man's strained face.

"I guess it's our finish, Jess," she said. "Funny luck we've had, isn't it? If we stay here, we'll blow up with *Old Grouchy;* if we go out there in the valley—dressed just in slacks and shirts and shoes like this—we'll smother and freeze in no time. But don't blame yourself, Jess. Coming to Mercury was my idea, too. I won't run out on any responsibility."

However, if she meant to put Jess Chandon's mind at ease, her words had an opposite effect. Alone, he might have given up; but the thought of brave, pretty, loyal little Lois dying here was unbearable. It produced a choking tightness in his throat, an ache in his heart, and a savage, lashing determination in his mind.

The threatening rumble inside the fuel tanks was growing progressively louder. Jess didn't speak for several seconds, but his brain was feverishly active, searching with lashing fury for some slender way out of their dilemma.

He knew that it was cold out in this deep, silent valley, where—since this was Mercury's Twilight Belt—direct sunshine never reached the ground. Out there, during certain portions of the short year of 88 terrestrial days, rare and super-chilled winds blew from the eternally darkened side of the planet.

The temperature might, in fact, approach or exceed —300° F. And Mercutian air—though it contains a high percentage of oxygen—is of such low density and pressure that there is little practical difference between exposure to it and exposure to the vacuum of the interplanetary void!

But then Jess Chandon's gaze fell on a bundle of oiled canvas which had been used to wrap a bale of supplies. Out of its presence, and out of the fierce, insistent activity of his mind, came the first glimmerings of a scheme. No one had ever dared before to face grim Nature in the way he contemplated; but for him and for Lois there was no other choice.

"Maybe we can live for a while out there!" he rasped suddenly. "Send an SOS, kiddo! Quick! Maybe they'll pick it up at the Mercury Station, and if they do—they'll try to find us!"

Lois shrugged as she hurried to the radio transmitter. She didn't know what Jess was talking about, and she doubted the ability of radio waves to reach the Mercury Station from here, because the electrical disturbances produced by the disintegrating dynamium in the fuel tanks must surely produce an almost complete blanket of static.

Meanwhile, Jess jerked the canvas from the rack where it had been carelessly bundled, and proceeded to straighten it out. It was perhaps five yards square. Then he procured two oxygen flasks, each capable of supplying the breathing needs of one person for an hour under ordinary circumstances, two pairs of gloves, two sweat shirts, and a can of thick grease. This last item he thrust into his hip pocket, where it would be within reach when needed. Articles of clothing heavier than those were not available. To add even an extra oxygen flask to the burden of the equipment selected would only have lessened his plan's slim chance of being successful.

THE HUM of the radio transmitter broke off suddenly, as Lois completed her brief and almost hopeless call for help. Now she returned to Jess' side.

"Well?" she questioned nervously.

Jess handed her a pair of gloves and a sweat shirt, and told her to don them. While he made similar additions to his own inadequate costume, he outlined his scheme as quickly and as clearly as he could. Lois nodded as comprehension of it came to her. She didn't comment, but a wan little smile trembled on her lips.

"Let's get lined up for action, then," she said.

"Good kid!" Jess returned. "I trust you in a pinch a lot more than many a man I know. Here. Take hold of this corner of the canvas, and hold it over your face. I'll do the same with the opposite corner. So! Now we'll pinch the oxygen flasks under our arms like this, with the valve-pipettes leading up under the canvas and into our mouths, thusly. Perfect, see? Next we move into the air-lock compartment, and close the inner door behind us. And now, until we make the dive out into the cold, I guess we're all set."

"All set!" the girl echoed with a tremor in her voice.

Cowled and enveloped by the canvas like a pair of Arabs, they paused for a moment in the narrow, closetlike chamber, peering from the tiny bull's-eye window in the external door to get their bearings exactly fixed in their minds.

The valley floor was a flat expanse of gray pumice, dust deposited here by the action of swift, tenuous winds. A huge, jagged rock, gaunt and black and fanglike, projected upward from its center, a low ridge of solid ground leading to it. Dotting the valley were spiny gray spheroid, half-embedded. Within their thick shells, moisture, which was absorbed during the rare times that a little of it seeped into the desiccated soil of the place, was sealed up. Those

spheroids might have been called plants, though their metabolism differed considerably from that of any terrestrial flora. And they were not actively alive now; the water in them was frozen solid, for this was clearly not a warm season.

What light there was came from two sources. In part it was sunshine, reflected from several of the more lofty mountain peaks, and in part it came from a throbbing, multicolored aurora, many times more splendid than anything of the kind that could have graced the northern skies of Earth. Torrents of electrons hurled from sunspots whose average distance away was only 36,000,000 miles could work miracles of moving, twinkling hues in the tenuous atmosphere.

There was a sickly, whitish yellow haze over the valley. The air was extremely thin, but the speed of its currents, combining with a feeble gravity, enabled it to support such fine débris blown from the frigid night-region. From a deep mountain gorge a creamy wisp, looking like a discolored cirrus cloud, projected. But it was only the path of the incoming wind, made visible by the dust and other solid material it bore.

NOW Jess Chandon's gloved fingers closed on the massive lever that operated the external portal of the air lock. He raised the lever slowly, and the valve swung outward. There was a faint, fading hiss as the dense Earthly atmosphere escaped. Then Lois and Jess were conscious of many dazing sensations.

Eardrums went taut and painful from the sudden expansion of air in eustachian tubes; deafness came suddenly, both from this cause and because there was no adequately dense medium to transmit sound. Eyes bulged, hearts raced wildly, and breath bubbled from lungs which had made no move to expel their gaseous contents. Stabbing pains shot through tortured flesh, strained by sudden expansion resulting from the abrupt and radical drop in atmospheric pressure. In a twinkling it had fallen from 14.5 to .05 pounds per square inch. Such a decrease—or in fact any possible decrease—cannot cause a human body to explode, as is sometimes supposed, but the attendant discomforts were anything but pleasant.

However, the Chandons did not lose their presence of mind. Luckily they did not more than feel the nip of the tremendous cold yet, swathed as they were in the thick canvas. In a fairly high vacuum—such as exists on Mercury—loss of heat is slow, for there is little conduction. Only radiation is unhampered, and the rate at which it can progress is limited. Their feet would necessarily touch the ground during the next few moments; but the shoes they wore—though pitifully inadequate for these regions by any standard of judgment—would nevertheless prevent direct contact of their soles with the superchilled surface of Mercury.

Following their scheme, the man and the girl first opened the valves of their oxygen bottles. The vital gas hissed from the pipettes which they held in their mouths; and they gasped to inhale part of its swiftly expanding substance. Much of it bubbled from between their lips, but a small quantity of it did get into their lungs—whether or not it was enough to sustain them while they carried out the next steps of their plan, they did not know.

The arrangement was far from ideal. Nowhere on Earth—except in the high stratosphere—were there pressure conditions similar to those which existed here. But breathing pure oxygen, even when much expanded, was better than breathing the thin, freezing air that blew from the land of everlasting darkness.

As matters were, the Chandons could not hope to remain conscious for much more than three minutes, unless they

could find a way to protect themselves more completely. And so, with the canvas held tightly around them, they rushed out of the air lock and along the solid ridge which projected from the treacherous, dusty soil toward the great rock.

Except for occasional glimpses through the texture of the canvas, to keep their bearings, they held their eyelids tightly down to shield their eyeballs from the deathly chill, and from the almost microscopic dust that found its way even through the fabric over their faces. Within their nostrils was the moisture of blood, oozing through ruptured mucous membranes.

Perhaps it was only the feeble gravity that enabled their energies to hold out until they had reached the huge rock and circled around it to its opposite side. At least they would be shielded here against the force of the explosion that was soon to come.

But their senses were all but gone. They could only stagger on blindly now, into the speeding, forceless wind, hoping that their feet would locate what they sought before oblivion came. Thus they blundered off of the stony ridge from which the great rock projected. The ground under them lost its firmness, as they had hoped it would. As in the case of freshly drifted snow on Earth, it was uncrusted. They sank to their knees in the fine, powdery stuff. The chill of it bit savagely into their thinly clad legs.

It was only the low heat-conductivity of the drifted dust that saved them. Had that conductivity been higher, the vital warmth would have been sucked from their limbs in a few moments leaving them stiff and wooden. But as matters were there was still time to accomplish their next move, if they could do so swiftly enough.

JESS jerked Lois' arm as a signal for the attempt. Immediately they both dropped to the ground. Holding their oxygen flasks as before, they clawed the edges of the oiled canvas tightly under them with fast-numbing fingers, causing it to wrap their bodies completely, like paper around a crude package.

The powdery soil yielded to their weight and to their feverish movements until they were shallowly buried in it. And they continued to wriggle to attain a greater depth, for only thus could they expect to last even for a little while. The dust above them would confine the gas hissing from the flasks, preventing its leakage through the canvas. Thus they meant to create a fairly airtight refuge for which their oxygen bottles would provide a breathable—if not exactly ideal—atmosphere.

And so, in frigid, inky blackness, they clung fiercely to each other for warmth. With a somewhat denser gaseous medium around them, balancing the internal pressure on their eardrums, they were again able to hear. But there was no sound within their canvas shell except the ragged rasp of their labored breathing and the rustle of oxygen blowing from the valves of their flasks lying beside them. They had a momentary respite, but it was not a particularly pleasant one.

Though no more than three minutes had passed since they had left their ship it seemed ages since they had rushed from its air lock. Now, however, their purpose in abandoning the doomed craft was brought forcibly back into their thoughts. The dust around them seemed suddenly to sway and heave like ocean waves. In their ears was a torturing, battering avalanche of sound, transmitted not through the thin atmosphere of Mercury above, but through the substance of Mercury's crust.

"That was the end of *Old Grouchy*," Lois sobbed at last. "Our pictures are all gone now! We—we——"

"Shhh!" Jess admonished soothingly. Rested a bit and refreshed by the rich

oxygen they were now breathing, they took the can of grease which Jess had carried in his pocket and applied the thick, oily stuff first to the canvas that wrapped them, and then to the exposed portions of their bodies. The purpose in doing the former was to make their shelter more airtight. The material was of undoubted value when applied to their wrists, faces, and so forth, for it was not only a guard against the extreme dryness to which they were exposed, but it also checked the rapid loss of animal warmth to some extent.

"Snug as two bugs in a rug," Lois commented, trying to make her words convincing. "I wonder if the men at the Mercury Station picked up our call for help."

IT WAS their last slim thread of hope, and so they made the most of it, though both knew in their hearts that there was scant chance that the SOS could have penetrated the static created by the progressive radioactive decay of the dynamium.

Neither of the two Chandons spoke again for some moments. Jess, fumbling in the dark, closed the valves of the oxygen flasks a trifle—an obvious gesture of frugality.

Minutes, registered by the luminous dial of Jess' wristwatch, ticked away slowly. Still there was no heavy thud of a rescue ship's landing.

"Ever hear of Harry Houdini?" Jess questioned presently.

"Yes," the girl replied. "He was a famous magician who lived three or four hundred years ago. He used to remain for hours in a coffin buried underground, and he used to do other similar things."

"Right," said Jess. "He had a system for such stunts. It was a kind of self-hypnosis. He relaxed completely to slow up his vital processes. He breathed very shallowly and slowly to conserve his air."

"I know," Lois answered. "But we haven't Houdini's practice. Besides, we can't do what he did because of the cold. Our bodies must burn lots of oxygen to keep from freezing here."

Jess changed the subject. There were other, pleasanter things to talk about—sweet, fragile dreams of theirs that soon would not even be dreams any more. But they found it nice to be able to talk about them anyway, even though they were destitute and doomed.

The oxygen flasks ceased to hiss. The air became stuffy now. It contained plenty of moisture at last, for in breathing the lungs exhale much water vapor. A large part of that moisture was deposited as ice crystals on the surrounding canvas.

Dazed from cold and growing frostbite, the Chandons waited for merciful oblivion. But for some unfathomable reason it was slow to come. The air was stuffy, but somehow this condition did not seem to increase.

Thirty minutes went by since the flow of oxygen from the flasks had stopped—an hour—an hour and a half. During this time the vitality of the marooned pair gradually waned. But this was not because the atmosphere they breathed no longer contained the element of life. In part it was simply that their endurance was giving out, though there was another, strange, ominous condition. The air within the canvas shell was growing mysteriously colder. This was so in spite of the reasonable supposition that their refuge, insulated by the drifted dust that enveloped it, should be warmed to some extent by body heat as it had been while they were still breathing oxygen from the flasks. As the moments went by, the chill tang of the new air originating from an unknown source increased, making each inspiration of it a torture.

The Chandons wondered vaguely why they were not dead, and how soon they would die. Then, during their last

minutes of consciousness, Jess hit on the proper explanation for their prolonged survival.

"The winds from the night hemisphere," he whispered painfully. "They bring dust to this valley, but they bring tiny crystals of frozen air, too. The two mix to form these drifts—a lot of dust to a little frozen air, part of it oxygen. The crystals don't vaporize easily, because—though it's comparatively warm here in the Twilight Belt—the dust acts as an insulator, keeping the warmth away. But the animal heat from our bodies is sufficient to cause some of the frozen air around us to volatilize again. It seeps in to us through the canvas. But of course it's got to be devilishly cold."

"Uhuh," Lois muttered sleepily. "What of it?"

Slow oblivion climbed over her. Jess moved laboredly for a moment——

IT WAS hours later. Lois Chandon had just awakened from the torpid sleep brought about by exhaustion and exposure. She could see that she was lying in bed in a little white hospital room. Half fearfully she looked this way and that. Jess was bending over.

"You don't have to talk, honey," he said. "I'll explain. This is the Mercury Station. We're under its airdome, and everything's all right. Nobody picked up our SOS, but—well—when dynamium disintegrates, it throws a lot of radiations into space. Some of them are like radio waves. A patrol boat's receiver picked them up in one big flash, when *Old Grouchy's* fuel tanks exploded. The direction finders pointed out their approximate source, and the rest was quite easy. The men on the patrol boat knew that the cause of the waves was probably a spaceship blast. It took a little time, but they scouted around till they located the place where *Old Grouchy* blew up. There wasn't much left of our ship, but so far as they knew we'd gotten out in spacesuits. The patrol boys did some more scouting on foot, and somebody saw a few footprints in the loose dust behind the big rock. The natural conclusion was that we'd just sunk out of sight in the powdery stuff. So shovels were procured to dig us out. And—we and our canvas cocoon were discovered. Dr. Arvin—the physician here—told me all about it."

Lois tried to smile in return, but her happiness and relief were tinged with worry.

"It's wonderful to be alive, Jess," she said, "after feeling sure that we were at the end of our rope. Only—only now we haven't anything left—no money, I mean—and we're millions of miles from home."

But Jess was grinning broader than ever. From a pocket of his borrowed trousers, he took a bundle of little blue slips of paper. They were radiograms—from Earth.

"I was going to tell you, but you didn't give me a chance." He laughed. "Heroes are never poor. Maybe we were crazy when we thought we could make something out of Mercury-pictures, but luck has taken a funny twist. We lived for over two hours under conditions practically as severe as those of the void, and we did so with only the crudest artificial aids. Well, *that's* something that nobody has ever done before! The result? You guess!"

"You mean—that they've heard about us back home?" Lois stammered.

"That's right!" Jess returned. "As soon as we were brought here to the station, our story—or as much of it as was known, or could be guessed—was radioed to Earth. These radiograms here are fan messages, mostly. There are three, though, from advertising agencies. One of them offers us a hundred thousand dollars to endorse the products of its clients. It seems a sort of crime, but maybe we ought to hold out on 'em a little, eh, sweetheart——"

Wayward World

By

Gordon A. Giles

It all happened on a world that—by all the laws of space—wasn't there!

THE superbullet of beryllium-bronze bored its way into the vacuum between the orbits of Saturn and Uranus. At either end mushrooming banks of slender rocket tubes were ready to belch out their thunder to slow or speed the ship. For twelve days now—since leaving Ganymede—their shining ship, the *Thunderbolt*, had plummeted the barrens of space, seeking a rendezvous with a mystery planet allegedly—but unofficially—glimpsed in the giant 200-inch reflector at Mt. Palomar.

Most of the *Thunderbolt's* bulk was taken up with fuel reserves and other supplies. The cabin in which the two human occupants ate, slept and guided the rocket juggernaut took up little more than one-fifth of the space at the nose. It was designed for the deeps of space, with a cruising range a score of times the distance between Earth and Mars. Its builders had launched it with pride.

"It's a wild-goose chase, I tell you," snarled Wade Welton. He was standing at the lee port, gazing out upon the limitless star-powdered firmament that seemed to hem them in closely, immovably. Yet the spaceship was arrowing through the void at a thousand miles a second. "We're heading right for the main street of dreamland."

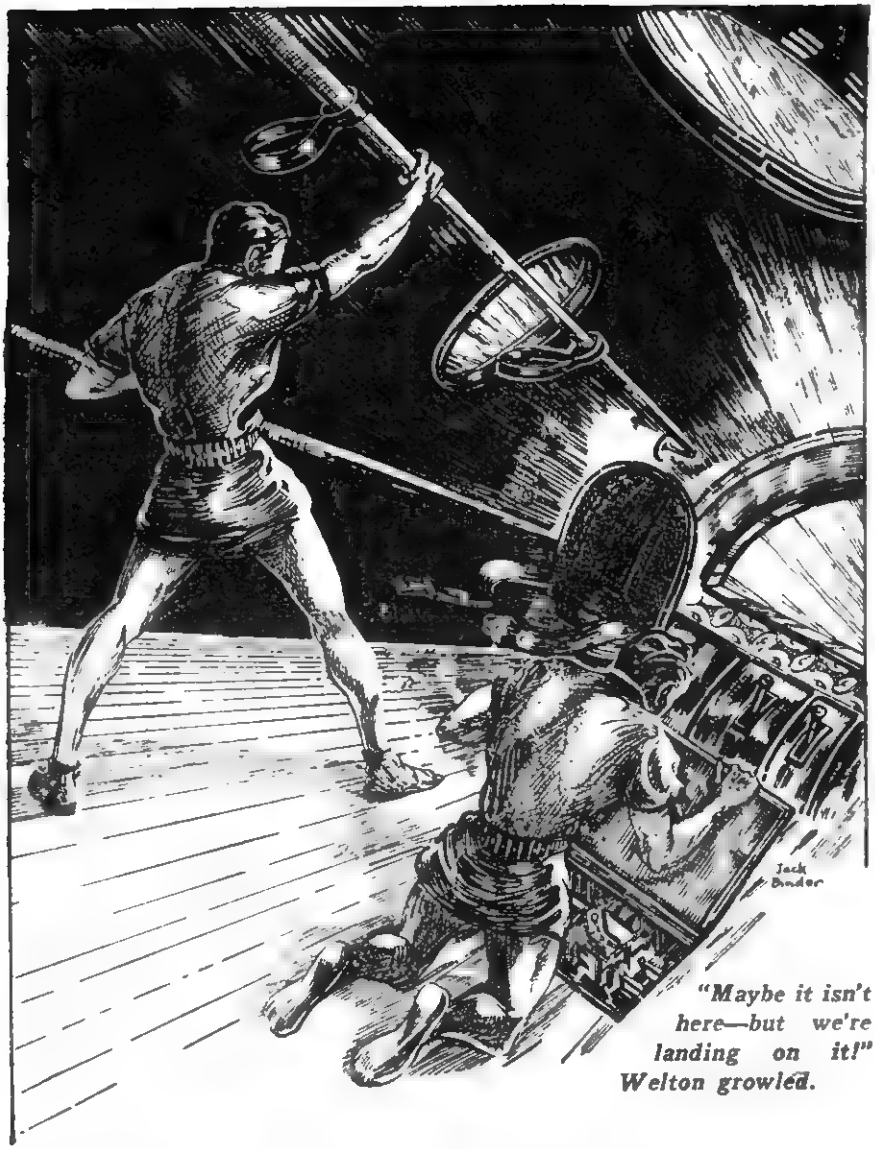
Archibald Quinley Osgood snorted. "You're a high-powered skeptic, Wade boy. But why should Solar Metals Inc. pack us into the latest model neodyne ship, fully stocked and fueled, if they weren't dead serious?" He took a turn or two in the cabin. "Why, it's a pleasure just to be in this space greyhound."

Welton's eyes searched the jeweled apex of the constellation Gemini—the "Twins"—ahead of them. For undoubtedly the hundredth time he hawked the space between Castor and Pollux. "It's not there," he said in the tones of a curse. "Not to the naked eye. Binoculars, on the other hand, make a mess of it, with so many pin-magnitude stars popping out. It's not there, Archie. And it can't be there. I'm glad to say I don't see it, since I consider myself reasonably sane. There can be no planet between Uranus and Saturn. A wild-goose chase in space," he finished emphatically.

Osgood grinned amiably. "Professor Malcolm Afferton is at the head of the batting list in astronomy. As director of the Mt. Palomar staff, he wouldn't be making wild reports."

"He didn't report this, though," reminded Welton. "Not officially. The 100-inch telescope on Ganymede has not reported it, and they're a lot nearer than Earth. At the time we left, they were going over old plates, trying to get a photographic sequence of the 12th magnitude planet supposedly spotted between the orbits of Saturn and Uranus."

"There's plenty of room there," argued Osgood complacently. "About nine hundred million miles."



"Maybe it isn't here—but we're landing on it!" Welton growled.

Welton groaned and thumped the side of his head with his fist. "Did you ever hear of perturbation, my microcephalic friend?"

"You mean like when I disturb you?" inquired Osgood innocently.

Welton released a hundred-candle-power glare and hissed, "Even if the alleged planet were the mass of Mercury, its gravitational effects would give Saturn's orbit a little twist, easily measurable. Also Uranus'. Even their moons. Now what do you say when some one insists that something's there

that ain't there? Because not by one pink inch is Saturn—or Uranus—perturbed other than by the known flanking planets."

Osgood munched a vitamin pellet thoughtfully. "But if it *is* there, Wade!"

"Then it has no mass—like your brain. No, Archie, it can't exist. We're turning back to-morrow, a couple of second—and second-rate—Columbuses who looked for a double-damned world in the wrong place in space."

BUT Welton was wrong. The next day a blue-green pin point spawned out of the void, flanked by Castor and Pollux. A mystery body that enlarged and outshone the stars. Its rapid inflation gave them a visual indication of their velocity. Welton muttered to himself at the discovery, but made no coherent answer to Osgood's sly ribbing.

"Pretty low albedo." Welton's puffed, sleepless eyes, after thirty hours of vigilant deceleration, stared at the approaching world. "Archie, get ready for some fancy maneuvering and a lot of piled-up inertia. I'm going to get on a tangent and slow down to three miles a second, which ought to be below the escape velocity of this Ethiopian member of the solar system. Ready?"

Osgood groaned in anticipation and tightened his belts. "Let her go, Wade. But I wish I could anchor my stomach down while you prove Euclid was a sissy with his straight line geometry."

Welton jabbed expertly at the controls. Relays opened the fuel valves wide. Fat sparks pulsed doubly rapid in the explosion chambers. The off-side bow tubes burst out volcanically. The momentum of the ship yielded before the hammer of reaction as though it had plowed suddenly into an area of thick, clogging syrup. Osgood cursed a steady stream at the racking shocks that battered him into the cushions as the *Thunderbolt* sideslipped off its former straight course. The stars wheeled dizzily.

Ten minutes later, Welton called off the demon of power and an aching silence came over the cabin. The ship was riding an even keel a thousand miles over a dark surface of indeterminate texture.

"I'm sorry that's over," lied Osgood, wiping a sweaty face. He eyed the terrain through the lower nose port. "Uninviting as hell frozen over. No atmosphere, I'd say—frozen."

They circled the globe once, unable to make out any distinguishing features beyond large areas of light and dark. "Down we go," announced Welton, retarding velocity. "Shall we land in a secluded spot and avoid the brass band? We—holy Andromeda!" He stared bug-eyed at the meters. Their readings had suddenly all become crazy.

"What's up?"

"Plenty. We're in a strong magnetic field, stronger than I've seen in a long time. Powerful enough to twist all my hairsprings out of whack. It's infernal!" He tried the stern rockets, to raise the falling ship, but there was no response. He tried the front rockets with a prayer, to curse at their failure. "Huh, playing tricks too. What next?"

As though in answer, a weird St. Elmo's fire began dancing along the central handrail and spread to every part of the cabin. And all over the hull of the ship, as they could see. A whistling sound from outside proclaimed an atmosphere through which they were dropping.

"Wade! The ground is coming up fast!" gulped Osgood. "Are we going to crash?"

Welton had ripped the panel away covering the distributor for the spark system. His eyes searched feverishly for trouble. It was hopeless to figure that out in the short minutes left. He straightened up with a bleak look.

Osgood met his eyes, and shrugged.

"Well, Wade, we've come a long way together." He forced a wry grin. "We will presently beat the well-known light-speed limit—by being infinitely remote in almost no time."

Welton watched the uprushing, dark surface in fascination. Then he wrenched his eyes away with a grin. "It's been a great game, Archie, hasn't it? We've just been dealt out, that's all."

THEY SAID no more and waited stolidly. They were not too shocked at this sudden appearance of disaster. In space, one had to expect catastrophe at any given moment. They had learned to expect the Grim Reaper on the shortest possible notice—none whatever.

The *Thunderbolt* plummeted down like its namesake. A screeching roar filled the overheated cabin. Then, as though it had struck an invisible rubber cushion, the mass of beryllium-bronze slowed in mid-air, retarded smoothly and swiftly to a stop, and oozed the remaining ten feet to the ground.

Osgood swam out of a temporary senselessness, aware of the miracle of being alive. "Wade!" he called hoarsely. "How can this be? But hurray, anyway!" He danced on his feet to keep the floor's terrific heat from working through his shoes.

Welton scrambled out of a corner, rubbing his hip and limping. "If this had been a steel ship, nothing would have saved us." He danced in company with his companion. Rivers of sweat ran down their faces.

"But what did save us?" Osgood insisted on knowing.

"Eddy-current losses. I should have expected it. Our ship cut the lines of force. Cutting magnetic lines always produces current. That was the St. Elmo's fire, from ionization of air. The current flowed in some pattern of circles around our hull, meeting resistance and dissipating our energy of motion as heat. The magnetic field acted like a viscous liquid, lowering us smoothly. Two things saved us—the great magnetic field with high flux density, and the *Thunderbolt* not being made of steel. The heat, Archie, is a by-product of our motion in this titanic magnetic field—a large scale hysteresis. Check?"

"You know too much." Osgood handed over a pillow for Welton to stand on, as he was himself.

"Mind, that's only a *possible* explanation," admitted Welton modestly. "Natural phenomena cover a wide range, and my physics do a little limping. And so will I for a while, the way my hip feels." He looked down, yawning. "I'd rather have my head on this pillow than my feet. Let's have general inspection and then cuddle in the arms of Morpheus."

"Righto," seconded Osgood. They found the air-regulator jammed, and sweated over it for a half hour in the overheated cabin. All else was shipshape, except for the engine. "But that," reasoned Welton, climbing into his bunk, "can wait." The lights went out.

Osgood's voice came solemnly out of the darkness. "Wade, that was what one might call a narrow escape, eh?" He wasn't sure whether his answer was a snore or snort.

OSGOOD pushed the vac-suit containing Welton toward the lock. "To you, my friend, goes the honor of first stepping out on planet X. I'll be out there in a minute." The seal's pneumatic valves hissed shut.

Welton jumped the five feet to the ground and landed with enough of a jar to realize surface gravity was at least Earth's equal. The gravity gauge in the ship had not been awry then. He swept his flash around. The ground was of a loamy texture, dark purple in color. He moved a few steps forward in his micro-mesh garment, to get out

of the shadow of the *Thunderbolt*. He winced a little at the pain in his bruised hip. Then he glanced around. It looked much the same through his glassite helmet as it had from the ship's ports—an endless, flat stretch of barrenness, without detail in the light of the somber stars.

Welton caught movement in the corner of his eye and turned swiftly. A tall figure loomed up in the dark. Welton limelighted it with his flash, then gasped and staggered back a step.

"Howdy, Columbus!" greeted Osgood cheerily. He was dressed in a Ganymedian parka, only the circle of his face exposed, but with his nose free to the atmosphere. He took a deep breath of air and thumped his chest while exhaling.

"Jumping Jupiter!" said Welton, gagging.

"Glorious to breathe fresh air for a change, Wade old stuff. Stuff is right, in that vac-suit. Why the devil are you wearing it?" Osgood doubled up in pantomime mirth. "You see," he explained, straightening up, "you took it for granted the atmosphere was unbreathable, and surface temperature down around the toes, as on most other extra-terrestrial globes. I, Wade, I took the trouble—before you awoke this alleged morning—to tune with my X-gun. It can give gases the Fraunhofer once-over with very soft X-rays. I found 40% oxygen, 50 of nitrogen, and 10 rare gases—close enough to Earth's mixture to satisfy me. And a little sulfur, but I can't smell it."

He sniffed noisily. "As for temperature—this will curl your whiskers next time you grow them, Wade—it's only thirty below zero, Centigrade. Nothing more than a nice cold Earth winter, or a Ganymedian summer. The pressure seems to be comparable to Earth's, too." He goggled in suppressed mirth. "I couldn't help it, Wade—it was too much fun seeing you wabble out in a vac-suit, like a sea-diver diving in a dry Martian seabottom."

"It's not so funny," came tinnily from Welton's suit. "I remember the time you used an air-lock three times on Earth, when the back end of our dry-docked ship was wide open." He gave a sour grin and changed the subject. "Well, here's your planet X, only it's probably an oversized comet. Anyway, what are we going to do with it? Looks like an unswept corner of purgatory."

A GUST of wind took Osgood's first words away and he had to begin again. "Wade, we're here on serious business. As Earth's first official landing party, we must take over the planet in her name." He added hastily—"If it is a planet, of course." He frowned. "Just what *does* a person say in a case like this?"

Welton grinned. "Sanderson, on Mars, is reported to have said: 'Mars, brother world of Earth,' since Venus had already been taken into the family as sister. You could perhaps say something original like 'planet X, uncle world of Earth.' Or maybe you could just sprinkle some of our earth-water on it and baptize it as a son of Mother Earth."

Osgood pointed to the horizon. "Jupiter rising. The sun ought to be up in a few minutes from this swift rotation, which I'd estimate at no more than ten total hours."

Together they watched Jupiter—a fiery first-magnitude-plus star—climb rapidly, like a giant firefly. Five minutes later a moon-sized zodiacal glow presaged the coming sun. It popped up with surprising brightness, though it was little more than an enormously bright star, well over a billion miles distant. Yet it illumined the surrounding topography with a far greater intensity than the full moon lighted Earth.

In the weird dawn, the surroundings were not so monotonous as had first seemed. A line of great cliffs towered

against the stars in one direction. At another spot in the distance, thick murky vapors hung in the air, as though arising from some steaming pool. Much of the horizon seemed taken up with jagged rock formations. The *Thunderbolt* had fortuitously landed free of these things, on a barren plateau.

Osgood reached down, and in the new light Welton saw what he had brought with him. First he came up with Earth's green-and-gold banner and stuck the end of its staff firmly into the soil.

"Planet Ten, unnamed, Earth's sons grant you Earth's protection and friendship," burst out Osgood sonorously, with a dramatic gesture. "If it is a planet," he capitulated to Welton.

Then he placed the United American banner of seventy-one stars and bars a little to the back of the first flag. "Planet Ten, unnamed but of Earth's empire, we hereby establish the sovereignty of United America!" he droned out. "If it is a planet," he added.

Welton looked on disparagingly. "Archie, that's silly. You know the awful squabble there'll be over this planet. Priority claims won't mean a thing compared to who has the strongest fleet and most nerve."

"If it is a planet," reminded Osgood. He bent over and scooped dirt into a glass dish with a spoon.

"What's that for?" queried Welton.

"Don't you know the rules? One must bring back a sample of the new planet's soil. They'll put it in a glass case in the Interplanetary Museum at New York with our names on it. We'll probably get a write-up in the Interplanetary Archives, too."

"Yeah, three lines of print in an overstuffed book to equal a month of stale air, sawdust food, and a square yard of spacesuit rash," said Welton scathingly.

But Osgood was staring at the spoon closely. "Say, Wade, look at these little purple growths—like algæ. Life on this planet! And if there's this, there's more and different kinds. Perhaps even X-ians. That is, a race of intelligent creatures. We'll have to practice up on our telepathy."

Welton moved toward the ship. "First and foremost, I'll have to get our rocket plant in running condition. Else we'll have to practice up on being marooned."

WADE WELTON sweated over the engine the rest of that day, mystified, for everything seemed in order. He pawed its parts from reaction chambers to spark relays and even tested the fuel without accounting for the reasonless failure of the unit as a whole. Like a possum playing dead, it was obviously ready to jump to life, but made no response to the controls. And these Welton had specifically examined for proper connections. He sat down to ruminate and scratch his head.

Osgood clumped in from the lock, clucking with his tongue. "Such language, Wade! If we hooked a pulley to it, we could drag the ship to hell and Halifax without the rockets." He set his portable mass-atom analyzer in its stand with a loving pat and leaned his comet-gun in a corner. Then he scrambled out of his parka, face red from the raw outer cold. "What seems to be the trouble—still dead?"

Welton brought out a curse, sigh and wail in one-two-three order. "Yes, and apparently gone to the Valhalla of engines. I can't get a thing out of it, not one miserable dyne of force."

"Dyne," echoed Osgood. "Dyne—dine——" He rummaged around in the food closet.

"And where all have you been?"

"Me, I've had quite a jaunt." Osgood continued between spoonfuls. "I struck due east and reached a forest about two miles along—huge fungoid growths, dead-white in color, angular in outline. Ghastly looking things in

this half lumination. I saw some vague forms skittering about farther in, and decided to stay out. I skirted the fungoids and hit one of the places where vapors arise. It's a sunken pool with some thick, murky solution in it. Sounds crazy, but it looked like molten metal with oxides over it. Animals in it, too, or fish. Saw 'em splash up now and then." His voice became preoccupied. "Plenty of life—queer."

Welton stared in mild interest.

"You see," continued Osgood, thus rewarded, "my robot atom-tagger indicated only the heavier elements, wherever I went. Zinc, lead, mercury, cobalt, palladium, radium, lots of iron, lots of manganese—all in a gnarled conglomeration of oxides and sulfides. The radium accounts for the abnormally high surface temperature, of course. The manganese for the purple color of the soil. But, Wade, where are the lighter elements—calcium, magnesium, aluminum, silicon, etc., which make up soil on all other planets? And where in the name of the bald gods is your carbon? It's impossible. A world without carbon. *Life* without carbon!"

Welton became interested. "No carbon, eh? What are they composed of, your fungoids, your fish and all the rest?"

"Metals and metal alloys, cemented together with oxides and sulfides. Robots of nature." Osgood grinned. "Wade, I can just picture dissection revealing lanthanum lungs, copper kidneys, tantalum toes, a beryllium brain and a——"

"Quit it," growled Welton, "or you'll say iron nerves, muscles of steel, silvery voice and heart of gold. It's not our place, though, to figure out their why and wherefore. Something for the biologists, when they get here. You may think your carbonless life is a mystery, but so is my ailing engine. Archie, we can't leave here without rocket power, and at present it ain't."

"In that case, let's stay a while." Osgood stretched, yawned, and moved sinuously toward his bunk.

THINGS stood much the same for three days. Osgood ranged far afield with his robot divining rod and each evening carefully filed the aluminum spectrum records away. These would be turned over to Solar Metals Inc. upon return, for them to lay plans for exploitation of metal resources. Welton, in that time, developed maniacal fits over the idle rocket engine, which he could not coax to the roaring life which should inhabit it. He became a little haggard over it.

"Wake up," commanded Welton on the fourth morning. He shook his companion insistently. "We have visitors."

Osgood rubbed sleep from his eyes. "Who, for instance?"

"Probably the mayor with the keys to the city."

Osgood stumbled to the nose port and looked out. A dozen squat figures were gathered in the half-gloom of broad daylight, apparently staring at the ship. They were misshapen to all earthly standards, huge and ungainly, glinting with a metallic sheen. Their several spindly legs had knee-joints pointing to all angles of the compass. The barrel-shaped bodies were equipped with a variety of tentacles and surmounted by cone-shaped heads. They looked something like caricatured spiders. There was a peculiar angularity about them, as though all their surface was composed of innumerable flat facets.

They were pulling up the two flags from the soil and examining them closely. Osgood picked up his Fraunhofer analyzer and trained it on them. "There you are," he declared presently. "Metallic intelligence—mainly iron and manganese. Creatures of crystal. In common with the fungoid trees, fish and other creatures I've seen, they're put together in angles. The little purple algæ

were asymmetrical crystals, you remember. What beats me, though, is their metabolism."

"They probably eat metal ores, and digest them with nitric acid," contributed Welton. "I've seen some outré beings in my time, but these galvanized gents stretch my credibility gland all out of joint."

"Say, look——" began Osgood.

One of the creatures, bulkier than the rest, experimentally snapped the staffs of the flags into pieces and then ripped the cloth to shreds, passing the débris to his fellows. Welton snickered while Osgood glowered. "They can't do that. I'm going out there and——"

Welton grabbed him by the arm. "No, you don't. Archie, don't pick quarrels with alien races—it's against the rules. You never know when you stir a hornets' nest. Just let them have their fun, as long as they stop with that."

They watched for an hour. The creatures seemed to be holding a conference. Finally they all separated, and began twisting themselves around, faster and faster, like animated tops. After five minutes of this they stopped, then lumbered away from the ship, with the peculiar ungracefulness of spiders. They disappeared in the gloom.

"Whirling dervishes," spluttered Osgood. "Now for Sirius' sake, tell me why they did that."

Welton laughed, but with an amazed look. "Sure, I'll tell you. Look." He had picked up the jar containing the soil and algæ Osgood had brought in the first day. As fast as he could, Welton swung the jar in a circle till his arm was tired. He held up the jar. "Quick, Archie—look! See the little algæ crystals glowing?" Then from his repair kit he picked up a small coil of copper whose ends were separated by a small gap. When this was rotated rapidly for a minute, a small spark snapped across.

"You and I don't feel it," Wade explained, "but we're in a really colossal and powerful magnetic field. Anything metallic, cutting the lines of force, produces current and hysteresis heat. The core of this world must be solid iron and completely magnetized. So what else could evolution do here but produce life utilizing that great source of power? Especially with the Sun and sunpower so remote. Their innards must be helices, to induce electric current as they cross lines of force which are all around. It's quite cute, when you think of it. They whirl—current generates, stores up. They are fed, as it were. That's what makes them tick. Of course, it doesn't explain their process of growth or reproduction, which must be some outlandish form of biometallurgy."

"Maybe they're mechanicals, robots," ventured Osgood, inspirationally. "Forged and welded and wired together, sort of."

WELTON sighed and turned moodily toward the exposed engine entrails under the floor plates. "Personally, I'd much prefer right now to know why that doesn't tick." He paced the cabin floor while Osgood slipped into his parka.

"Why not come along with me? Wade, you need some fresh air. It'll clear the cranial cobwebs. You're so deep in a stew of chemically pure befuddlement that you can't think straight any more."

Welton grumbled, but donned his parka and went along.

As they strode crunchily toward a valley in the distance, an anemic sun spattered the topography with eerie, dancing light. Welton watched his wrist compass perform weird gyrations, often jumping a quarter circle without warning. Periodically Osgood stopped to use his atom-indicator on the soil underneath.

"Seems to be some of the lighter elements after all." He wiped his eyes clear of tears from the cold. "A pinch

each of magnesium, calcium, silicon, boron, chlorine, even beryllium. But no carbon, not one wretched atom of it. Wade, those X-ians can't have sugar in their coffee. In fact, they can't have coffee. What a world!"

"I agree," Welton nodded awkwardly, holding his fur glove over his nose to warm it. "Archie, you don't realize the half of it. This close-to-Earth-gravity means it must have about Earth's mass, though narrower around the equator. Yet it doesn't exist, this world. It can't, for otherwise it would markedly perturb Saturn and Uranus. It doesn't exist. Archie."

"So we aren't here, either?"

"Damn it, it's easier to believe that than the other. And this magnetic field has more twists and convolutions than a snake. In fact, it isn't just one field; it's a dozen or a hundred built up in concentric cones. Some physicist is going to come here some day to plot it out and go gloriously mad."

"How do we know we're not mad?" philosophized Osgood. "See those fungoid trees, fifty feet high if an inch! They weigh tons and tons, Wade, of almost solid metal. How can they *grow*, and stay together?"

"And my engine," said Welton with a ferocious growl. "I've gone over it bit by bit, almost atom by atom. It's perfectly O. K. Yet it won't even cough out one erg of energy."

"Then it's agreed that we're insane?"

"It's us," assured Welton. "Or else it's all a dream. Because if it weren't, the whole universe would be thrown out of whack. We can't let a little personal pride bring on the collapse of the cosmos!"

"Wade, I know what happened. Remember when the ship came down—fast? We were killed there. It's just our spirits walking around on some ghost world." Osgood shifted his comet-gun to the other arm. "That critter there, climbing a tree—a ton weight slicking up like greased lightning. A manganese monkey. By the way, could a ghost be insane? Are we both?"

They stood at the crest of the long, low valley and peered into its shadowed depths. The queer, faceted life seemed rampant in many forms among the giant growths that glinted nakedly in the sunlight. They were strange growths, vegetable only in being rooted in the soil, fungoid in appearance. Once they saw a huge bulbosity with spikes strike down a many-legged monstrosity and begin to devour it. The metallic crunching of its great jaws came to the two humans. They even seemed to see friction sparks fly from the process.

WELTON unlimbered his zero-gun. "I'm curious to know——" he began vaguely and aimed for a small shape skittering in the open. He fired once, frowned, then sent three more bullets at the creature. It went on unconcernedly.

Osgood whistled. "Wade, if you missed four times in a row, this is all a dream."

Welton reloaded but did not fire again. "The funny thing is, I didn't hear any of those shots strike. They should have made some sort of clatter, with all this metal around." He looked up. "Sun's setting, Archie. Let's go back."

Osgood giggled suddenly, as they were on the return trip. Welton started to growl at him but the sound changed to a nervous laugh. In turn, then, and sometimes together, they chuckled fitfully, choking down peals of laughter with an hysterical edge to it.

"Nothing to worry about," gasped Osgood between fits of merriment. "Just the high percentage of oxygen getting us. I felt it the other times I was out, too." Then he burst out into gales of involuntary laughter, joined by Welton.

Like two madmen with an overdeveloped sense of humor, they staggered back toward the ship. The sun was

Mushroomlike in shape, they had the glint of metal.

low on the horizon when the *Thunderbolt's* clean-cut lines materialized out of the gloom. Both knew the horrible fit of laughter would not leave till they were safe inside.

The windy gusts in Welton's throat died abruptly, however, when they came closer. "Archie, in the name of Pluto, do you see what I see? Or am I having a personal hallucination?"

"I'll tell you just what I see," Osgood proclaimed. "And you check on

me. I see about thirty of those overgrown spider-men we saw this morning. Half of them are supporting one end of what looks like a heavy cable. Its bulging end is being pressed against the lower curve of our ship's hull. Damn it, it looks alive, like a leech, and like the same is attaching itself to the metal. The other half are doing the same on the other side with another hawser. That's what I see. Now you tell me what they aim to do, Wade."

The pulsating terminus of the heavy cable flattened itself tightly against the hull as they watched. At times ripples ran through the length of the cable, as though it were alive. The spider beings continued to hold it in position until the bulbous end had quieted its movements. Then they let go. The enlarged cable end remained firmly affixed. The rest of its fifty foot length trailed along the ground, twitching gently.

"It *is* alive!" Welton hissed. "It's some infernal metal snake biting its way into the interior, I suppose, with diamond fangs and acid digestive fluids. Here—Archie—watch your step——"

But Osgood had already lumbered forward. "You can't do that!" he shouted at the aliens. They paid absolutely no attention. He ran to within twenty feet of them and raised the comet-gun belligerently. "Call off your pet or you get some of this!"

As though he were truly the ghost he had mockingly called himself before, the aliens were completely indifferent. By not one recognizable sign did they betray awareness of his presence, or his voice, or the ominous gun in his hands. Osgood went completely berserk. Aiming the comet-gun straight for the massed group, he pressed the trigger savagely. The ionized beam of violet that gave the gun its name streamed backward from the breech chamber, indicating that its nozzle was pouring out the deadly shock-beam. Yet not one of the spider creatures fell. In fact, they paid no more attention to it than they had to its user.

OSGOOD sprayed them several times in hopeful desperation, then flung the gun down in disgust. Grabbing the zero-gun from Welton as he came up, he pumped ten shots in quick succession at the aliens. They stood there adamantly, unmindful of the steel hail.

With a wild look in his eye, Osgood leaped forward with the gun upraised like a club. Welton grabbed his arm, planted his heels in the crumbly ground and jerked him back. "Let me go!" roared Osgood, tugging furiously. "I'll teach them what's what around here. I'll kick them halfway around this planet. I'll——"

"You'll come with me—quietly," countermanded Welton. "Archie, snap out of it. You can't touch them. You saw what a comet-gun and bullets did —or didn't do—to them. They're juggernauts of iron and manganese and what-not. Animated powerhouses. Your kicking them would have about as much effect as an amœba bumping into a whale. Come on." He dragged the cursing, hot-eyed Osgood toward the ship, after picking up the comet-gun. He fairly pushed him into the lock. Then he turned and shook his fist at the aliens. "We shall see, my fine friends, we shall see!"

Inside the comfortably warmed cabin, they faced one another querulously. Without anticipation Welton snapped the motor switch. It was still dead.

"Wade, we can't admit we're beaten." Osgood was still panting, still growling in anger. "I'll bet a hearty clout on the brainpan—if any—would teach them a little courtesy. They ignored us like we were a couple of gnats come to bother them. Wade, I'm going out there with a six-foot length of handrail and——"

"Shut up!" Welton rubbed his

chapped face reflectively. "Archie, we're up against it b-a-d—bad. Those metal monsters are up to something and it won't be to have us meet their wives. We're of no more concern to them, apparently, than a couple of thinking gusts of wind would be to us."

"And what's to be done?" stormed Osgood, clipping the corners of the cabin. "We can't just sit here while that snake thing eats through the hull. I say let's give them some strong arm. They can't be so almighty impervious to a good clubbing. A few good——"

"Archie, will you please pipe down and get that oxygen jag out of your head. This is a case of brain against brawn. They have it all over us physically. Metal bodies, elephantine weight, and the direct energy of electricity for muscle power. But I doubt they have much of a brain. Perhaps none. Per——"

He stopped, peering out of the port. Though quite dark except for starlight with the sun gone, he was able to make out the spider beings in their queer, whirling dance. "Storing up power—lots of it," he muttered wonderingly, as it kept up for many minutes. "Now what——"

A moment later there was a tremor in the ship, followed by an unmistakable jerk. "Would you believe it?" Welton's eyes strained into the night. "They're dragging the ship away. Those cables—alive or not—are just cables after all, by which they are going to take our ship wherever they want. Half of them are tugging on one line, half on the other. So that was it!"

"But where to?" Osgood gulped, amazement succeeding anger, as the ship began moving steadily over the ground.

Welton snorted. "Do I know? To some hellish fate we can't conceive. They want the ship, not us. They want the metal. We've either got to rescue our ship or be marooned on this frozen ball of metal. Now take it calm, Archie. And don't try to sneak out. I have some A-1 thinking to do."

WELTON'S thinking occupied most of the short six-hour night. But it seemed long to the fûming, impatient Osgood. Even food did not come to his mind. The *Thunderbolt* moved over the plateau flats steadily. At times it rocked crazily as it was dragged over distortions of the terrain outside. A continuous scratching sound filled the cabin from friction between the hull and coarse, rough ground.

At dawn Welton jumped up. "It's worth a try."

"Anything is," agreed Osgood eagerly, reaching for a wrench with which to loosen the handrail.

"Telepathy is what I mean, Archie. It's the one means of contact between alien minds that always seems to work. If I can contact them mentally and get an idea of what it's all about, maybe I can argue them out of anything rash."

"They don't look arguable to me."

"Let's go." Welton, after donning his parka, stretched himself in his bunk. "Put me in the cataleptic, Archie. I want full contact. But don't forget to take me out of it in an hour. You know the danger of staying in the cataleptic state longer—breakdown of the central nervous system. In plain words, insanity. Snap it up."

A bit nervously, Osgood performed the series of operations leading to the third and final stage of hypnosis. Trained as they were in this useful art, with Welton not only a willing but eager subject, it did not take long. Osgood's staring threw Welton into somnambulism. His low-voiced murmuring then brought lethargy. His command of "Sleep!" many times repeated, finally produced catalepsy, with Welton's eyes closed and his breathing slow and deep.

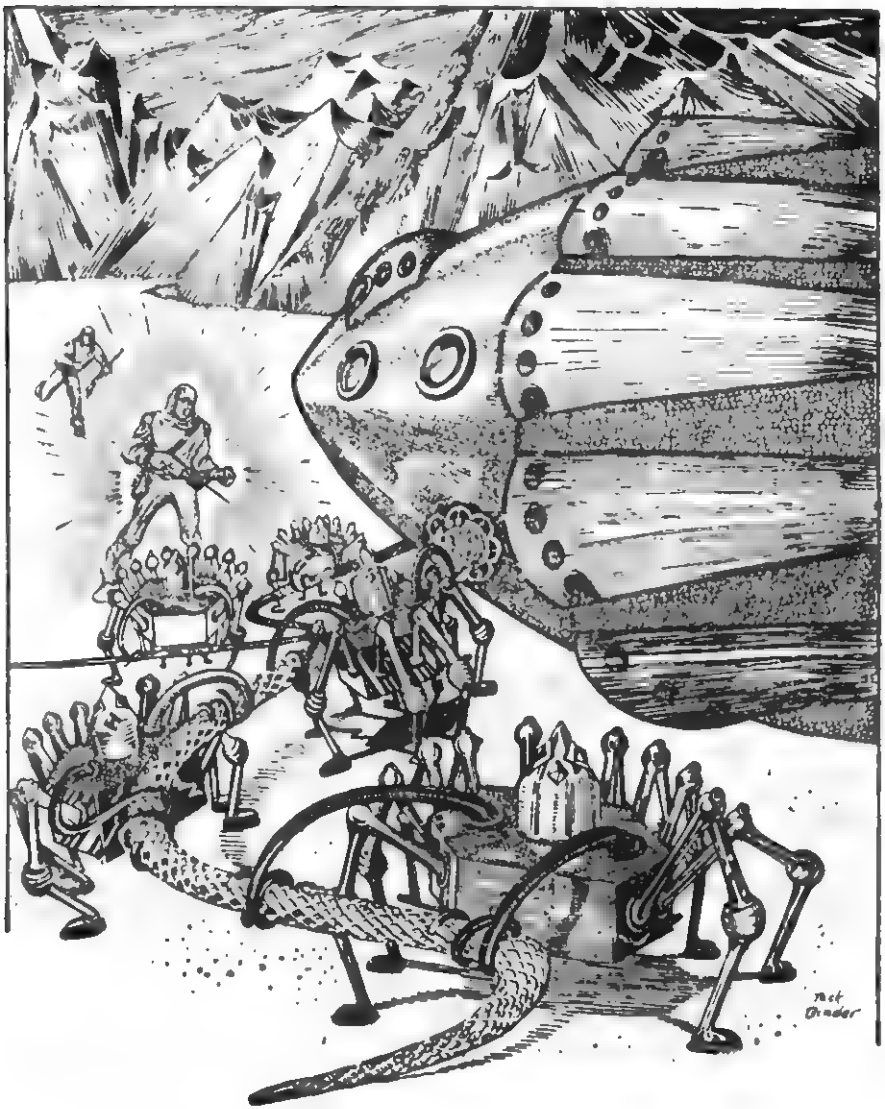
Osgood waited a full minute. "Open your eyes, Wade. Get up. You are

under my command. Help me take down this handrail and——"

"I am not under your command." Welton's lips barely moved, but they were firm. His eyes were flames of living force.

Osgood shrugged. "I guess you aren't at that," he muttered. "O. K., have it your way. Go out and establish telepathic communication with the aliens. But only for an hour. Then I'll awaken you. Remember, one hour."

Welton intoned an affirmative and strode with a strange stiffness toward the lock. Osgood watched from the port. He saw his friend's figure walk



Living metal snake or plain steel cable, the gun had no effect.

around one group of unnoticing aliens dragging at a cable, and take up a path between the two groups. For several minutes nothing happened. Then quite suddenly all the aliens stopped, as though at a command. Heads turned curiously. Faceted eyes stared at Welton, or in his general direction.

"Ah!" murmured Osgood. "At least he's got their attention. I was afraid they weren't anything but soulless, mindless machines."

Welton stood there, face set and grim, eyes flashing fire. Osgood imagined he could hear his telepathized message, though he knew the mesmerized Welton had automatically attuned his mental vibrations to those of the aliens. Osgood was out of range. The whole purpose of telepathic transmission in a hypnotic state was to achieve mental rapport in some range unattainable to the conscious mind.

WELTON stalked in in precisely an hour, and stood before Osgood obediently. "I am now in your command," he said. Osgood took a sheet of paper and held it before Welton's eyes. "Wade, you are at the edge of a high cliff. Take a step forward."

Welton took a step. "You're falling, Wade! Wake up!"

Osgood jerked the paper away and caught Welton as he stumbled forward. Welton, pale of face, looked up with a weak grin. "All right, Archie. It's a hell of a way to come out of a cataleptic state, but the quickest and surest —if you have a strong heart." He sat down on his bunk weakly.

Osgood waited patiently. He had experienced those awakening symptoms himself.

"Thus and so. We live again." Welton tried his legs and managed to stagger to the port. "I thought so," he complained bitterly, as the aliens again took up their writhing cables and trudged forward. The ship bumped along noisily, a weight that a hundred Earthmen could not have moved an inch.

"They go their way and we go theirs, eh?" Osgood clamped his teeth together with a grinding sound. "Wade, what do you think about a quart of neodyne fuel would do to those high-handed gents? Nicely packed in a jar with a percussion fuse? See——"

Osgood held it up. "I figured your peace parley would have about as much effect as a debutante trying to reform head-hunters. You've been out. Now it's my turn. A little moral persuasion, as it were——"

"Wait!" Welton went on slowly. "I don't want you to try that—yet. It'll be the only way to do it in the end, but——"

"Why wait then?" Osgood was bewildered.

Welton waved an arm vaguely. "It's hard to explain, Archie. Damned hard. I couldn't possibly hope to change their minds about this taking of the ship. It's very important to them. In fact, I didn't contact their minds at all. Not in any normal way." He shook his head helplessly. "Look, Archie, they think in mathematical symbols. They are creatures of crystal, their minds, too. We are amorphous. We think in abstractions, circumlocutions. In curves, so to speak. They—built up mentally and physically in a linear existence—think in straight lines. And in numbers. And in formulæ, constants, equations. They must know incredibly more of them than we. We arrive at ours only through elaborate experimentation, with laborious plotting and inadequate instruments. They conjure them up in their minds, perhaps are born with them. We humans have elements of error in our mathematics and much theory in its application. These creatures can make no mathematical errors, and do not theorize They know!"

Welton choked for breath. "Gosh,

Archie, these beings know many, many things. Perhaps they know everything. I only groped in the fringe of their mental radiation. I was like a cork in a whirlwind, vaguely aware of what must lie further in. I did not even attempt to find out why they are taking our ship. I could not phrase my questions in the language of formulæ they speak. So my quest was useless in that respect."

"Exactly. Wade, I don't know any more than you what it's all about, but here's one equation I know that they don't. One quart of neodyne plus one percussion fuse equals big noise, much wind, and many, many flying pieces of our cast-iron friends. Now what are you grabbing my arm for——"

"Archie, I said my quest was useless in that respect. But not in another. I was on the verge of learning something important." Welton, dead serious, would not let go of Osgood's arm. "No, not anything directly concerned with you and me here, but things about—oh, about the universe. Archie, as you're my friend, let me go out there once more, as a cataleptic. Just another hour and then you can give them hell with the neodyne bomb."

Welton was pleading, rather than asking. Osgood hesitated, muttered a while, then gave in. In another five minutes Welton stalked out of the cabin, deep in hypnosis. He did not return on the hour, and Osgood went out to get him in. He carried the jar of neodyne in his hand. Welton stared at him dazedly as Osgood commanded him three times to enter the cabin. Osgood grew afraid.

Then he ran a hundred yards in front of the two marching columns of aliens. They paid him no attention. Grinning cynically, Osgood laid the neodyne bomb down directly between the oncoming parties. He jerked out the pin of the percussion fuse and sped for the ship. Welton walked along dazedly, still lost to conscious life. Osgood tossed him over his shoulder and ran for the lock. Inside, he threw Welton's stiffened body in his bunk and strapped him down.

Then Osgood crouched down in a corner, wincing in anticipation. At last it came—a thunderous explosion. The roaring voice of the most powerful chemical known to science. The ship's motion stopped. A hail tattooed against the nose of the ship for many seconds. With a prayer of relief that the bow ports had not been blown in, Osgood ran to look.

Welton was there ahead of him. "Good boy, Archie!" he cried hoarsely. "That blast took me out of catalepsy like nobody's business. And that's about the end of our sweet little pals."

Together they stared at the abysmal scene of ruin. A great crater yawned just beyond their ship's nose. There was no sign of the aliens except for one lone figure that picked itself up a hundred feet away and swayed drunkenly. Then it whirled in its dance of energy absorption, stopped, and scuttled away on its spidery legs as fast as it could go.

"Damn," swore Osgood. "One got away. That's bad. He'll round up some more of his fellows and they'll start it all over. Well, we have exactly four hundred gallons of neodyne, which is barely enough to blow up about sixty-five thousand more of the blasted animated iron-mongery."

He idly fingered the starting switch of the engine. "If only this ornery machine would——"

A soft roar answered him. They looked at one another in confoundment. Welton dashed for the controls and tested his levers. In answer, the rear rockets greeted his touch with sulfurous drumming. The ship trembled.

"It works again!" Welton announced with a foolish grin.

Osgood grinned just as foolishly, then kicked the wall. "Wade, the irony of it," he moaned. "Perhaps it was in working condition all the time we were

being dragged willy-nilly over this tin world. One concentrated blast from the nose rockets would have blown our reception committee out of the known universe!"

OSGOOD watched planet X change from a bowl of mud to a ball of slate, then dwindle rapidly. "Whew! When will the walls cool off, I wonder? Going through those lines of magnetic force just about grilled me, no less. Good-by, planet X, and good riddance. Say, Wade m'lad, how do you explain the engine working all of a sudden like that?"

Welton sat happily at the controls. "Archie, it's simple. I can explain everything. Of course, just my own way of explaining, but it'll do for you, won't it? That was a sarcastic grunt, Archie, but I'll skip it.

"You see, the terrific magnetic field down there is not a simple thing like the pretty lines of force shown by iron filings around a small magnet. Oh, no. It is a vastly complicated thing. It's built up in concentric cones. Now, at the apex of any cone, there is an area under stupendous strain, for metals. We just happened, by that strange law of chance which more often than not pops up at the wrong time, to land at the exact apex of a cone of magnetic force. Consequently, every bit of metal in the ship, and in the engine, was warped under the strain. Even the most slightly paramagnetic metals were influenced in that titanic, colossal, Gargantuan, etc., magnetic field. Thus friction—magnetic friction—kept the engine's parts locked rigidly. As soon as our friends had moved us from the spot, the engine must have been in working condition."

Osgood looked sour.

Welton went on loquaciously. "I can explain several other things, too. Our metal bullets did not harm the metal beings because they did not reach them. You see, the speeding bullet, cutting so many lines of force in its flight at such a great velocity, simply melted from hysteresis. Now the comet-gun and why it failed. The comet-gun shoots out a static charge that shocks the victim's nervous system. Kills him, much like lightning, except that lightning isn't a controllable beam. But, of course, our X-ians didn't have any nervous system. Or if they did, it probably carried twice as many volts as our shock-beam! And thus ends the saga of two intrepid discoverers of planet X."

"Not quite." Osgood stared curiously at his companion. "For the first time in history, a person in the cataleptic state failed to obey his self-induced command, when I had to bring you into the ship bodily. What in the blue blazes accounts for that?"

Welton's eyes grew suddenly bleak. "Archie, I'll never be able to explain that to you. I don't know myself, except that maybe an inner force stronger than even that hypnotic command wished me to stay there, and keep on—learning. I was just beginning to be able to talk in their language, in the tongue of the cosmos. In the language of laws, equations, and fundamental expressions. Suddenly I realized I could learn from them the first and last law of the macrocosm—that law behind all laws. I fed the aliens all the mathematics I could think of, hoping to draw it from them. I pumped out Planck's Constant, Einstein's Formula, Maxwell's Equation, the basic charge of the proton—everything. I almost got it, Archie. Almost, but not quite. Perhaps I could never get it. Maybe it is beyond human grasp. Those creatures know a law that would fit the universe like a glove. I almost had it——"

His voice faded away. Welton was deep in some maze of thought. "Knowing it, I might have become a superman, the master of the universe——"

"Then why aren't they?" queried Osgood crisply.

"Because they are slaves of metal. They are like a genius on a deserted island who mentally figures out a way to make gold from cotton, but has no cotton. They know the great law of the cosmos, but can't apply it in their lack of common, ordinary materials. By the way, Archie, do you know why I think they wanted our ship so badly? Beryllium is sprinkled in their world like salt. Perhaps it is salt to them, as indispensable as salt to us. Our ship may have been just a spice to them. Remember that the cable-thing fastened to our hull with all the earmarks of a greedy animal plumping down on a cake of salt. Or maybe I'm crazy."

Osgood laughed suddenly. "Wade, if that isn't a planet because of lack of perturbation, and isn't likely to be a comet because of its size and mass, what is it? *What world have we just been on anyway!*"

"It can't be a planet," raged Welton, as though he had been touched off by a hairspring. "Unless all the present-day laws of gravitation—whether Newtonian or later—are mathematical absurdities." He frowned. "There must be some complicated explanation to it that only the spider chaps back there know——"

FOR FIFTEEN Earth days the *Thunderbolt* dropped through space. When Ganymede had become a small disc, radio signals began to come through. Osgood transmitted a contact request for MacDuff of Solar Metals Inc., to be relayed via a large station that handled calls from ships. A few hours later MacDuff's clipped voice answered. He gave a short greeting and stood by for a message.

Osgood reported. "I thought I had great news for you, MacDuff, but I don't know. The new world would be all metal if it existed. Do you hear me, MacDuff? All metal, from tip to toe. But you see, it doesn't exist. Welton says it can't exist or else it would have been discovered long ago by perturbation of Saturn or Uranus. That's probably over your head, MacDuff. You and Solar Metals Inc. will probably send ships there and dig up a fortune without stopping to realize it doesn't exist. That's all, MacDuff. Standing by for your comments."

Two minutes later, MacDuff's voice came again, between gusts of laughter. "So that had you boys worried—no perturbation? Listen carefully. Palomar has just completed a survey of all old star maps and figured it out simply enough. They were able to compute that this planet has an orbit *at right angles to the plane of the solar system.* Does that help? They have already devised a theory of planet-formations to account for one being there. I'll meet you at the docks."

"What are you doing?" asked Osgood curiously, as he turned around.

"Kicking myself. I'm going to spend the next month eating ashes. Naturally, that explains it. With its orbit crossing the plane of the solar system only twice in about forty-five years, and only once in hundreds of revolutions coming near either Saturn or Uranus so——"

Welton groaned miserably, leaving the rest unsaid.

"Buck up," consoled Osgood. "After all, in calling it planet X, we were dead right. In Roman numerals, 'X' means ten, and it is the tenth planet discovered. Of course, if you insist, I'll help kick you when your leg gets tired."

Harnessing Earth's Heat

by Willy Ley

The second of the short series of articles on

Power Plants Of To-morrow

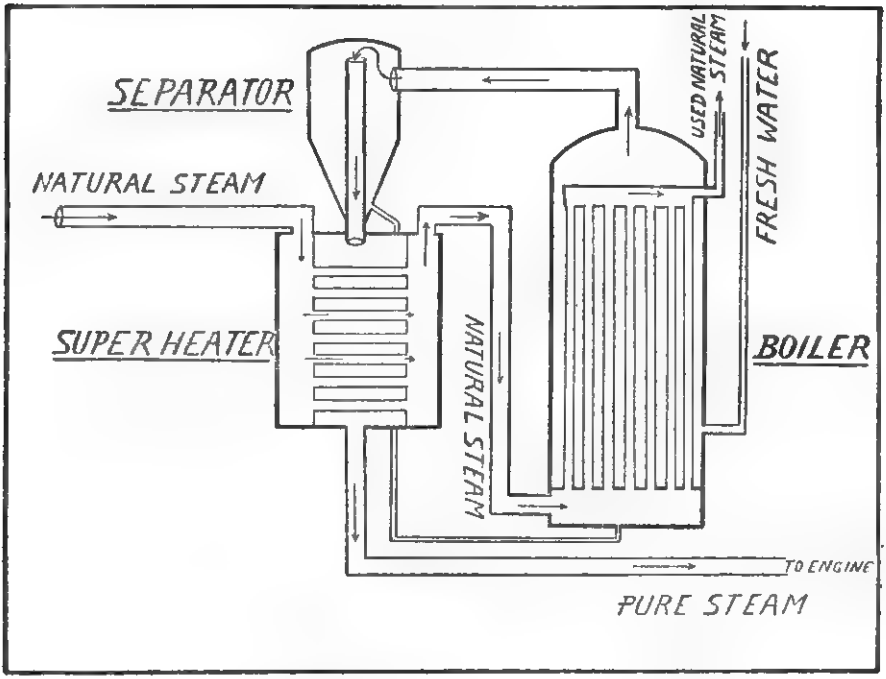
IF it is too difficult to harness the energy of the sun's rays directly, and if we have to make a roundabout way via wind and other air currents, half of the million and one "inventors" who busy themselves and bother others with their plans will reason, "why not harness the heat of the Earth?"

They then usually proceed to remind you that the ground grows hotter and hotter the deeper you dig—about one degree centigrade for every 100 feet of depth—and develop their ideas about a gigantic power plant intended to harness the heat of the bowels of the earth, and to furnish the energy needed by five or six cities of respectable size.

All these "plans" look much alike. A shaft of comparatively large diameter is to be drilled three miles deep into the ground. Then a large cave is to be excavated at the bottom of this bore and another shaft is to be cut upward from the other end of the artificial cave. While the digging of the shafts, and the excavation of the boiler are admittedly difficult—there may be a natural underground cave of about the required size and depth handy somewhere which would make matters much easier—the rest is very simple. A large river of about the volume of the Mississippi is to be led to the mouth of the first shaft, in which a series of water turbines and dynamos have been installed. The water of the river, following the well-established laws of gravity, will fall into the shaft like a waterfall. The waiting turbines will convert its kinetic energy to rotary motion, which in turn is converted into electric energy by the dynamos. This play continues until the water has reached the bottom of the shaft and arrived in the underground cave. It may be, it is asserted, that the water has changed to steam during its descent. It may also be that it did not have enough time to do so. If it did not, it will change to steam in the cave. If it arrived as steam, this steam will receive more heat and develop a higher pressure. Finally, it will escape through the second bore where its energy is to be gradually absorbed by a series of steam turbine units. Eventually, the river will emerge in the form of hot water which may serve further industrial purposes.

While the basic principles of this scheme are sound, it is of no practical value because there are still other sources of power that are much less expensive, even if it be assumed that the two shafts and the underground cave could be built.

This dismissal of a dream does not prove, however, that there is no future in the utilization of the earth's heat. Actually, even at present, the Earth's heat is being utilized commercially in at



Flow sheet of the redesigned Larderello natural-steam power plant

least two places, one in Italy, the other in Iceland.

The Italian town of Larderello, but a few miles from Pisa of leaning-tower fame, boasts the first volcanic power plant on Earth. Larderello is situated practically in the center of a mountainous area which is dotted with signs of volcanic activity. There are no plants growing at the foot of the mountains, but everywhere steam escapes with a loud hiss, and sometimes with a thunderous noise, from the numerous cracks in the rocky mountain slopes. The Italians call these steam geysers "soffioni." Usually hot springs—*lagoni*—can be found in their immediate vicinity.

For more than a century a chemical industry of rather unimportant proportions utilized the *soffioni*, as well as the *lagoni*, as sources of boric acid, which can be found in the water in a fairly high percentage. About 1904, the leading men of the firm Società Boracifera di Larderello, which then controlled practically all of Larderello's boric acid business, conceived the idea that they could well use some machinery which would conveniently be driven by the natural steam of the *soffioni*. Thus, they reasoned, their business books would not show any expenditure for fuels, and bought a 40 HP steam engine. As the engine was originally installed at Larderello, it had no boiler; there was enough fairly high-pressure steam escaping from the *soffioni*.

The men that had conceived the plan, the engineers that had installed the engine, and even the workers that were relieved of much hard labor, could well be satisfied with the success. The engine was running day and night, and was running smoothly. There was no trouble with the boiler, and no delays on account of late fuel deliveries. The unique

power plant worked miraculously well.

But the joy was not to be indefinite. A few years after the installation of the steam engine, a report came from the power plant that the engine had suddenly decided to go on strike, and could not be persuaded to resume work. An investigation committee came, its members made serious faces, and finally took the engine apart. When they looked at the interior their seriousness was quickly replaced by astonishment. It was unbelievable that the engine had worked as long as it actually had. All its inner parts had corroded away. The combined actions of boric acid, ammonia and sulphuric acid—to mention but a few of the "impurities" of the natural steam of Larderello—had been too much for the metal to stand.

IT BECAME necessary to buy a new engine, and to change to another system of utilizing the driving power of the steam. A boiler was shipped to Larderello, designed to furnish the steam for a 300 HP steam turbine coupled with a dynamo. The boiler was heated by the natural steam from a number of artificial *soffioni*. Holes had been drilled into the rock in places where natural steam could be expected, and these artificial *soffioni* worked with greater regularity than the natural ones. This new system prevented the impurities of the natural steam from attacking the engine itself. All that could possibly be destroyed by chemical reactions were the heating coils in the boiler. But these could be replaced easily and inexpensively when necessary.

This was in 1912. When, in 1914, the World War broke out and the demand for electric power jumped to unbelievable heights, the Larderello power plant increased quickly in size and in output. In 1916 it could furnish 7500 kilowatts, a few years later 12,000 kilowatts, and now approximately twice as much. The plant is now serving the street cars and many industrial plants in five cities: Volterra, Livorno, Siena, Cecina and Firenze. By its very existence, the Larderello plant proves that the utilization of the Earth's heat is more than a dream. But it indicates, at the same time, that the Earth's heat can be utilized efficiently only in places where it comes comparatively near to the surface, i. e. in volcanic regions.

There exist many places of this kind that are promising. Unfortunately, they are usually far away from centers of civilization where the power is needed. Some cities, however, have hot springs comparatively near by. One well-known example on the European continent is Budapest, the capital of Hungary. More than 20 years ago, Dr. Szilard Zielinzky, professor at the College of Technology in Budapest, evolved the plan to heat the entire city by means of the hot water of these springs. Although he had worked out his plans completely, so that they should have convinced even the greatest skeptic, nobody listened to him.

Recently, his plans have found recognition and were used—with some alterations and adaptations, of course—in another country and for another city.

The city is Reykjavik, capital of Iceland. There are hot springs, the springs of Rogvigen, in its immediate vicinity. The experimental power plant that is to heat the city eventually, is situated in the Reykir Valley, only ten miles from the heart of Iceland's capital.

Fourteen hot-water wells have been drilled in the Reykir valley, producing about 100 quarts of water per second. The temperature of this water is close to the boiling point. The deepest bore goes about 370 meters (approximately 1200 feet) down. There appear to be large, subterranean, hot-water lakes in underground caves at this depth.

THE FUTURE of Reykir valley, and of Reykjavik, depends on a few simple figures. They are now pumping

100 quarts of almost boiling water from the huge underground lakes each second. They hope to produce 200 quarts per second within one or two years. This would suffice to heat all of Reykjavik and environments. If they succeed in producing 300 quarts per second, there will be no need for fuels in Reykjavik.

These successes of the Larderello and the Reykir valley engineers have resulted in many similar attempts and investigations. The third volcanic power plant that comes into existence will probably be the one of Pozzuoli, near Naples, in Italy. Here, the volcanic heat of Mount Vesuvius is alluring. The fourth volcanic power plant may be erected on Java, where investigations of the steam geysers of the volcano Kavah Kamodyang started in 1926. It was calculated that a power plant of Larderello pattern in this spot would be able to produce electricity at one-fifth the cost of a large existant water-power plant near Kavah Kamodyang.

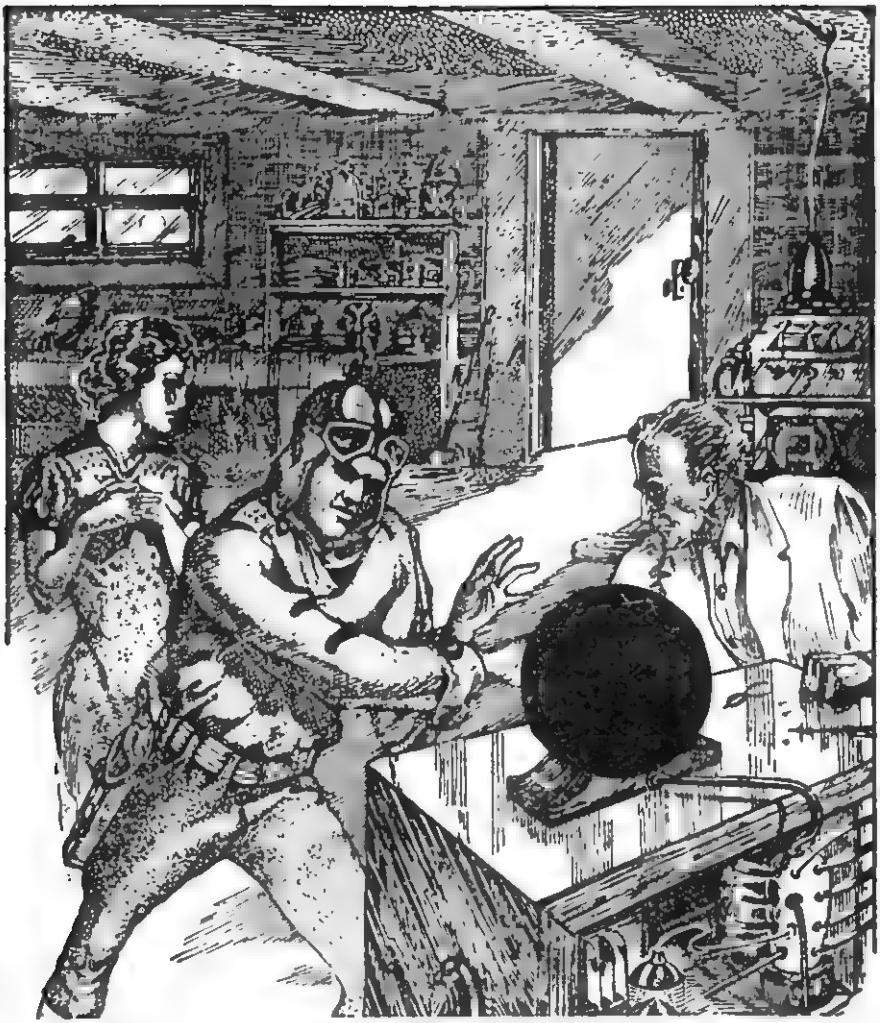
Japan, New Zealand and Alaska have other promising spots.

But the United States may still beat Java. In the summer of 1921, engineers and geologists of the General Electric Company investigated the Mayacama Range, forty miles south of San Francisco. This chain of mountains shows many dead volcanoes, and in its western parts a large number of steam geysers. Probably, there is still a vast amount of hot lava to be found not far underneath the surface. It heats the rock of certain areas to such a temperature that water begins to boil in holes that are only two or three feet deep.

A number of borings were made in these areas, and it was found that conditions for a volcanic steam power plant were even more favorable than near Larderello in Italy, where a commission had been sent for study. This commission reported that the Italian engineers had to drive their drills to a depth of about 200 to 400 feet to obtain steam at a temperature of about 180° C. and at a pressure of 45 pounds per square inch. The technique of boring developed in many years of practical work, consisted in drilling holes 16 inches in diameter. While the drilling progressed, these holes were lined with seamless steel tubes, welded together. When the steam-filled cavities were about to be punctured by the drill, a type of piston was inserted in the tubes and forced downward as far as possible. It was then rapidly pulled out by means of an electric motor, in order to create a partial vacuum in the tube which assisted the upward pressure of the natural steam, and enabled it to break through the thin layer of rock and lava not penetrated by the drill.

It appeared that matters were much more favorable in the valleys of the Mayacama Range. Bore holes not as deep as those in Italy, yielded large quantities of steam at a temperature varying between 150° and 180° C., and at a pressure of almost 200 pounds per square inch. However, no power plant has yet been built in California. Only a small set of steam turbines and generators was installed, which furnished current for heating the canned foods of the camp, lighting it, and for making further experimental bore-holes. It was found that neither the volume nor the pressure of the steam from these holes dropped noticeably during the time of observation, even when a new bore hole was placed in the immediate vicinity of an existing one.

It is therefore still possible that the third volcanic power plant will be situated in the United States, if Java or conceivably Budapest do not take the third place for themselves. At any event, the thrilling business of digging volcanic steam power plants has only started, and will in all probability result in a new industry that will help considerably to satisfy the power needs of mankind.



The Anti-weapon

a short novelette by

Eando Binder

IT came suddenly, but he did not curse his luck. To Dick Elson there was nothing like a good fight —as long as there must be fighting. First the windless, cloudless, stratosphere had been of pristine clarity. The war and all its grimy messiness lay far below. Then suddenly, out of nowhere, had appeared three enemy ships with their dragon emblem. They had im-

from which he had run. The sign—scorched by some livid flame—barely revealed that this had been a restaurant.

A nauseating stench came from the glassless showfront, nor did it look inviting inside. But Elson went in holding his nose. He ran to the back, where the kitchen had been, and sought the pantry. Sure enough—in here was a nice supply of canned foods that the foraging army had missed or not bothered with in lieu of larger supplies.

ELSON gathered an armful of cans without discrimination and staggered out the back, since that was nearest. Out in a comparatively sweet-smelling alley, he examined his stores and pounced eagerly on the three cans of tomato juice. Kicking the tops in with his booted heel, he drank gratefully.

"Never knew this stuff could be so damned good!" he commented aloud as he gulped down the last can. Then he dropped the empty tin with a clatter. The noise seemed to roll endlessly in the general stillness. Silence again. Suddenly he stiffened at a slight scraping sound, jerked out his gun, crouching for instant movement. Then he gasped and felt a little foolish. Peering at him from behind a heap of shattered brick was a girl, her large blue eyes staring from him to the heap of cans and back again.

Elson stood for a moment, stunned at the incongruous picture of beauty in the background of the ugly, battered city. Finely molded features framed by a cascade of honey-colored hair gazed at him quizzically. The misfit men's clothing—boots, cavalry pants, leather jacket—could not fully hide young, feminine curves. Suddenly the pert nose wrinkled and the girl was laughing softly. Elson felt more foolish.

Somehow, the first thing he thought of saying was, "Say, it's dangerous for a girl like you to be wandering around alone in this jungle. There's wild men around who——" He stopped, confused.

"I have a gun," said the girl, patting her hip pocket. "I take it out when I think I'm in danger."

"Thanks for the compliment," retorted Elson. "I'm Dick Elson, of the Other Side to you. You're a citizen of this city, I suppose. We're enemies. You'd better go your way, and I'll go mine. I'm repairing my ship at——" He bit off his words. No use revealing everything.

"My name is Lorna Davidson," vouchsafed the girl. "And I'm hungry. I've been looking around for food, for myself and my father." Her eyes were again on the cans at Elson's feet. He saw that she didn't look too well fed.

"Here," said Elson gruffly, "take this stuff—all you can carry. I can get more, in there. You——"

He sprang forward as the girl turned pale and swayed. She was in his arms only a moment, then struggled erect. "It's nothing," she murmured. "Just the air and—and——" She was sobbing suddenly, on his shoulder.

When she had recovered, Elson said, "I'm taking you home to your father. But first, something to pep you up." He crushed in the top of a can of diced fruit with the butt of his pistol, handed it to her. She turned away to hide the fact that she was wolfing it down.

While she ate, Elson went back in the restaurant and came out with two big paper bags loaded with cans. They stuffed their pockets and left, with the girl carrying a third bag filled with tinned foods. She led the way out of the alley and turned into a broad avenue which had once been a scenic boulevard, lined with grass and shading trees. Now a remnant of surviving greenery struggled to bloom in the torn shambles.

"We live a few blocks from here, down this street," said the girl, picking her way carefully between tumbled walls.

former landing field of an airport, miraculously clear.

The little fighting ship, flapping its left wing like a great mechanical eagle, glided down and bumped along the concrete runway. Its right wheel struck a chunk of masonry that had been blown from a near-by building in the bombardment. The ship uptailed and Elson slid out of his open cabin door, skidded on his leather-covered back for twenty feet, and then rolled another twenty.

HE GOT UP dizzily, then sat down to contemplate the miracle of being alive. An hour later he felt better, though bruised and shaken. He looked around. The ruined city all about seemed utterly deserted; not a sound came from its battered environs. Alpha-charges, proton-blasts, neutron-beams, deuteron-flames and other agents of demolition had done a thorough job. Undoubtedly, electron-rays had swept the streets and byways to heap up the electrocuted dead.

Elson knew the city—knew where he was. This had been an enemy city, razed by His Side. But they had not succeeded in capturing this salient. He was about thirty miles back from the lines, in enemy territory. He would be shot on sight, when discovered. The Atom War was one stripped of all humaneness; a struggle to the finish between the world divided into two great camps, with fighting going on interminably on a dozen fronts.

Elson's only chance of life was to get back to his own lines. A thirty-mile jaunt through the thickest of enemy forces was unthinkable. He must repair his ship. He could not signal distress with his radio, for the radio had been directly in the path of the alpha-charge that had brought him down.

He hauled out his tools with a philosophical shrug and went to work on the tattered wing. Its gauze-metal covering was intact on the lower side and would furnish sufficient sustaining surface. The task remained to anchor it more solidly to the fuselage. He tightened struts and did some crude welding of torn connections with rocket fuel. Night descended with the job scarcely begun and Elson slept in the cabin, on its hard, metal floor.

He didn't dream. Those who dreamed during the Atom War went insane.

In the crisp, glowing dawn, Elson decided he was hungry and thirsty—particularly the latter. He started out on a foraging jaunt. He put his slim, black alpha-pistol in his coat pocket within easy reach, and headed for the nearest unblocked street. As he went down the littered avenue, he stared about curiously. He had never before been in a city after its destruction and found it awesome, frightening. He resolutely avoided looking at the queer huddles of charred putrescence he passed. His nose wrinkled. He began to wonder if he was really hungry. But he was thirsty.

He turned at the next block, to keep near the airport field. He jerked his pistol out suddenly. A slinking, wild-haired figure darted from a near-by doorway and scampered ratlike behind the ruins of a stone building that lay half over the street. Elson did not shoot. Evidently the creature—from the look on its face—was a half-mad scavenger whose mind had been blasted by the bombardment, though his body had escaped. Perhaps he had lost all his loved ones—seen them die before his eyes. All razed cities contained these scuttling, mindless beings, grubbing among its ruins for food.

The question was—where would food be found? Perishables were long gone, of course. Canned and stored supplies were always stripped from a city by whatever army occupied it immediately after it had ceased burning and crumbling. Elson had an idea when he saw what the wild man had dropped—a can of tomatoes. He turned to the doorway

from which he had run. The sign—scorched by some livid flame—barely revealed that this had been a restaurant.

A nauseating stench came from the glassless showfront, nor did it look inviting inside. But Elson went in holding his nose. He ran to the back, where the kitchen had been, and sought the pantry. Sure enough—in here was a nice supply of canned foods that the foraging army had missed or not bothered with in lieu of larger supplies.

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"We live a few blocks from here, down this street," said the girl, picking her way carefully between tumbled walls.

Elson could see her shudder every time they passed nameless shapes around which buzzing flies hovered. They were mainly skeletons with shreds of clothing hiding obscene bulges. Once they came upon a mangy dog, snarling wolfishly, munching with sharp teeth at one of the bodies. Elson set down his cans and put a hissing alpha-charge through the beast, revolted deep within himself.

"How long have you been in this God-forsaken ruin—and why?" Elson failed to see that.

"Ever since the—the bombardment, six months ago. It was awful—five days of destruction from the sky—screaming—fire—death——" The girl's whole manner betrayed an inner hysteria at the mere recollection. "My father and I survived—miraculously—in the basement of our home. My father is—well, he didn't want to leave. I've been going out every few days, dressed in men's clothes, a cap over my hair, but I lost it to-day. Food is harder to find every day. They have plenty of it in the soldiers' garrison at the other end of town, but I would not like to go there—again. They drink and sing, and other women——"

SHE LOOKED up at Elson. "War is so cruel, so terrible!" she cried. "And so senseless!"

Elson walked on stonily, though her words echoed in his mind. Quite true—but he could see only one road to peace. The girl turned before an apartment house whose upper stories had been blown to atomic dust. At the basement entrance in the side gangway, Elson set the cans down and murmured a farewell, but the girl put a hand on his arm.

"Please—let my father thank you for your kindness."

"No need," said Elson shortly, turning on his heel. He turned back again and involuntarily drew his pistol as the door opened. The old, hollow-cheeked man who stepped out peered with sharp eyes at Elson. He had recognized the pilot's uniform as that of the Other Side.

"Your pistol, man, put it away," he said deprecatingly.

"We're—enemies," reminded Elson. The mutual atrocities of both sides in the Atom War had engendered a flaming hatred between the two warring peoples. Yet Elson realized he was doing lip service to a code rather than speaking his own inclinations.

"We were human beings with a common heritage before we were enemies," retorted the old fellow crisply. He stepped up to Elson, stared shrewdly in his face. "Would you shoot me and my daughter down in cold blood? Of course not, nor would I you. Enemies—silly prattle of the propagandists in this mad time."

"But I must go," insisted Elson in stiff tones.

This time the old man was in the way. "You have befriended my daughter. You have brought food. Share one meal with us. Your commanding officer will never hear of it."

Elson flushed, stung. He pretended not to notice that the girl beside him had again put her hand on his arm, and had said, "Please do!" Nor that she smiled warmly as he nodded.

"Come in, then," said the old man eagerly. Elson followed thoughtfully, wondering why he was smiling so strangely. There was something in all this that Elson didn't quite fathom.

"I'm Professor Davidson," said the old man as they ate of canned salmon, peaches, milk and pudding. "Scientist, retired, and"—he smiled whimsically—"formerly well-to-do. I own this building—what's left of it—and have carried on private researches for the past ten years in this laboratory."

He swung an arm to the back part of the long, low chamber. Elson glanced again at the paraphernalia there. In the gloom of the basement the various ap-

paratus assumed fantastic shapes. He made out what seemed to be a modification of a proton-blast projector.

"I am still carrying on my researches," continued the professor. "But it is trying at times. The city no longer furnishes us with electrical power, water, or easily available food."

"Why have you stayed here?" queried Elson. "There are a hundred other cities——"

"Ah, but this is the *safest!*" chortled Professor Davidson. "All those other cities are open to attack—any day, any minute. It stands to reason that *this* one won't be bombarded again! I might not be so lucky in another air raid in some other city as to live through a holocaust that wiped out seven-eighths of this city's population. And I had to have—must have—freedom to finish my work!"

He had said the last with a sudden flare in his eyes. He lowered his voice again and went on. "Fortunately, I have a Diesel generator for electrical power and a supply of oil from this building's oil-burning heating plant. Water—plentifully bestowed from Heaven—we caught in barrels outside. Of course, we boil it before use. Food—well, that has been poor Lorna's job and she's been a thoroughbred about it. We've never really lacked for nourishment because of her tireless efforts."

"Except lately, father," reminded the girl. "Yesterday I couldn't find a thing all day. To-day——"

"You started very early to-day," burst in the professor, as though on sudden thought. "At dawn, Lorna! You weren't heading north, were you? Toward——"

THE GIRL'S hand trembled in the act of lifting a spoon. Father and daughter exchanged glances. It came in a flash to Elson. The soldiers' garrison, at the other side of town—they had plenty of food, as the girl had said. Had she been desperate enough to think of going there? Elson knew what a guard garrison was like—one that was supplied with drink.

The professor was speaking again, a startled note in his voice. "Lorna, I've told you—you must never——"

Elson rose to his feet, face hard, interrupting. "How can you risk your daughter's life and—and safety like that?" he demanded icily, though there was a storm within him. "You, professor, have stayed here like a cowering rat while she has had to go out foraging among slinking brutes, human and otherwise, to keep you fed so that you could putter around here——"

"Stop! Don't say that to my father!" Lorna was also on her feet, indignant, angry. "It is *not* puttering. My father's work is important. I'd make any sacrifice for that to go on. Even the garrison!"

Elson stared at the girl in astonishment, then sat down. "Perhaps you'd better tell me just what this is all about—this experimentation that seems to be so important."

The old man nodded. "My scientific work in the past ten years has been in the field of astrophysics. But I chose the unorthodox line of attempting to do things *without* space-time, rather than with it. Space-time, briefly, is the particular matrix in which this universe of ours is cast. Yet it must be contained—in a larger sense—in another matrix. Space is not the absolute nothingness popular fancy pictures. It is warped and altered by the matter within it. It carries radiation, transmits energy. True nothingness would not do this.

"But—suppose there were a true nothingness—a real blankness—an ultraspace. What would it be? It would not carry radiation or transmit energy. It would not carry the warp of gravitation. Time would not exist in it. Matter would be in a static condition in such an ultraspace. It would be lightless, heat-

less, soundless, timeless. It would be a negativity of space. It——"

Professor Davidson glanced at Elson's blank face, coughed, and began again. "I'll skip the technicalities. At any rate—I succeeded in achieving this ultraspace. Come over here to my apparatus."

When they had reached the other end of the chamber, Elson looked at the affair with puzzled interest. It had been installed in a radio cabinet, and resembled vaguely the inner parts of a radio receiver. One of its tubes was ten inches high, knobbed with a dozen lead-ins leading from the tube's heart to various coils. The tube was rather shapeless and looked homemade. The old scientist explained with pride that he had blown it himself, and had built its complex interior bit by bit. One of its insulated leads trailed to a globe-shaped wire basket a foot in diameter resting on the cabinet's top.

The professor pointed to this. "In here my ultraspace is formed. I will only explain that the large tube below is one which absorbs energy and grounds it into the earth. It sucks all energy from within the wire globe. And because space-time—in inadequate wording—is a form of energy, it sucks space-time from that wire globe—leaving *nothing!*"

He snapped a switch and the Diesel generator burst out in a bull-like roar. It subsided to a steady drone after a moment. The scientist went around to the front of the cabinet and fingered its controls. Within the box, a queer hum arose. The big tube glowed suddenly in phosphorescent splendor.

"Watch the wire globe!" cried the professor.

ELSON saw its interior gradually darken. Soon it was opaque—seemed to have turned to a solid ball of ebony. The surrounding wire shimmered and vanished. Then, in the next five minutes the ebony ball became impossibly blacker, till it hurt Elson's eyes to look at it. He was a little dazed. Somehow it was like looking into a stupendous, yawning cavern.

"Now," called the scientist above the droning, whining noises. "Take out your alpha-pistol, plunge your hand into that globe and fire the gun." When Elson obeyed wonderingly, but hesitated touching the black globe, the scientist shrilled, "It won't hurt! You won't feel the wire. It's within that globe where two things *can* exist in the same space—or in *no* space! Good—now turn the pistol at Lorna's heart and pull the trigger—oh, all right then—my heart!"

Elson's flesh crawled. He had thrust his right hand into the dense black globe up to his wrist, with the sensation of pushing it into a bowl of mercury metal—pliant, faintly resistant. Hand and gun had disappeared completely in that ultra-night. He shook his head at the professor and pointed the pistol—at a guess since he could see nothing of his hand—at the wall. He pulled the trigger—again and again. Nothing happened.

He jerked his hand out, muttering, ran to the door and when outside tried the pistol. A hissing charge went up into the air. The drones died away as Elson came back in and the scientist met him at the table, motioning to the chairs.

"Naturally the globe of ultraspace I made is imperfect," said the professor. "Otherwise, you would not have been able to move your hand at all. You would not have been able to hold the pistol—or pull the trigger. It cannot drain the subtler energies of the human body, but it can—as you saw, cancel the coarser energies of the alpha-charge." He looked quizzically at Elson.

"A nice little scientific toy," shrugged the pilot.

The scientist went on, as though he had not completed his sentence, "—and

of the proton-blast, neutron-beam, deuteron-flame, electron-ray, and all those other gigantic energies with which mankind is slaying itself!"

Elson stared, dawning comprehension lighting his eyes.

"I had already developed this ultraspace before the war. I was satisfied in having achieved a scientific milestone. Just when I was ready to publish my results—the war broke out. The world was drenched in blood. Then it struck me that my ultraspace could be a great anti-weapon. No destructive agencies could operate in a zone of ultraspace. I reasoned that if I could find a way to project my ultraspace from a distance, and enlarge its sphere of activity to include entire battlefields—you see? Strangely, it takes very little power to produce a large amount of ultraspace. The energies that are absorbed from it may in turn be used to run the original apparatus that extracts the energies. A closed, self-dependent system—almost a perpetual motion machine.

"I went to work. I had nearly finished making a workable ultraspace projector when this city was attacked. I waited here, praying that I would be saved for more than just my life's sake. We lived through it, Lorna and I. Since then my work has been slowed, but it's done. It stands there the anti-weapon!"

He pointed to the machine that to Elson had looked like a proton-blast gun. The pilot sprang to his feet.

"Why are you telling me all this?" he exclaimed. "Such an anti-weapon would mean victory for the side that has it. I have promised nothing to you—tried to go away. Now you have me in a peculiar position. The military leaders of My Side would give their eyes for the anti-weapon. And the military leaders of Your Side——"

"Your Side! My Side! The Other Side!" scoffed Professor Davidson. "Meaningless rhetoric! Only chance governed your birth on Your Side. If you had been born here in this city—you would be on My Side. The whole war hinges on pronouns such as those. It's as silly as tweedledeedee and tweedledeedum!"

HE GOT UP, began pacing the room, face aflame with some inner fire that had smoldered for years.

"I am not on Your Side. Nor am I on My Side. I am on Neither Side! Or better yet—I am on Humanity's Side. No, Elson, I am not your enemy, as your attitude betokens. This anti-weapon will not be used to bring victory to either side. It is to stop the war altogether, at its present dead-lock!"

The struggle within Elson was plainly visible on his face. Certain things had seemed crystal clear in his mind. That His Side must win—that only in that way could peace be attained. Yet he had unconsciously hated that concept all the time.

Professor Davidson stepped before him, spread his arms. "My boy," he said quietly, "if I am your enemy, so be it. Here I am—unarmed—helpless. All you have to do is pull out your gun—destroy me—and your way is clear to insure victory for Your Side. My daughter could not stop you."

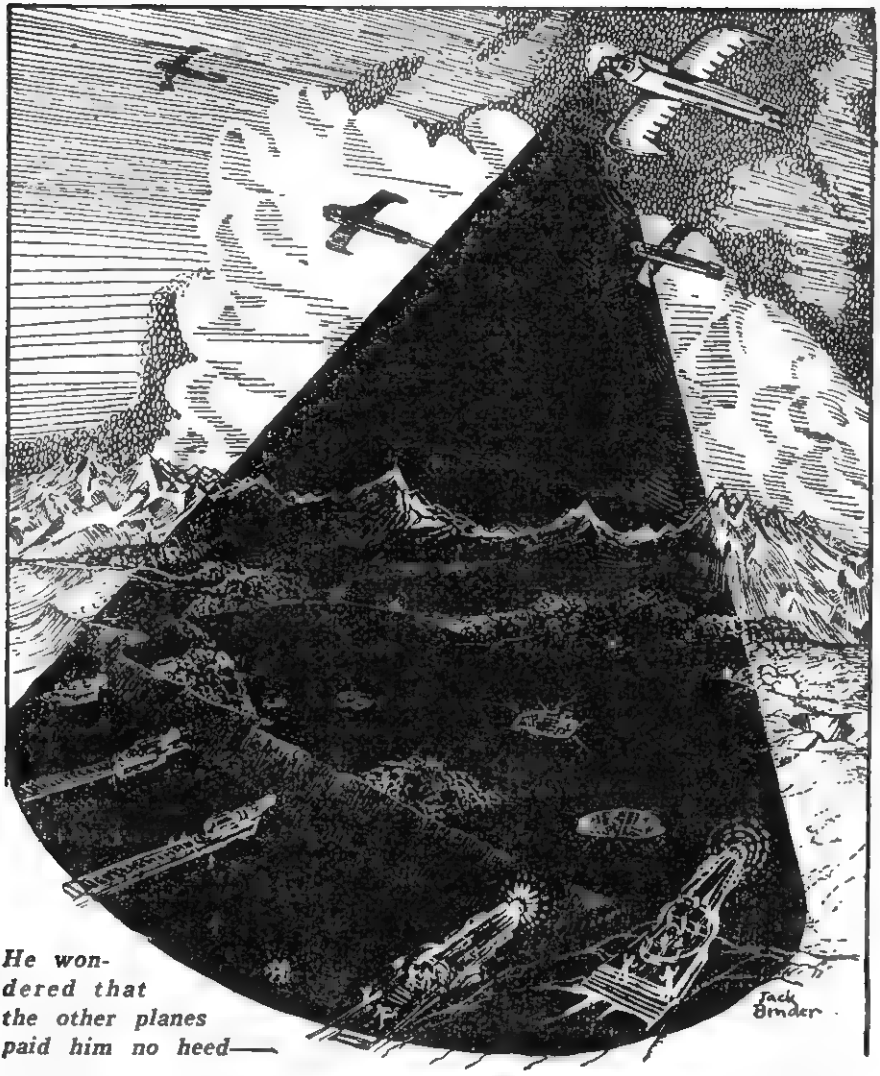
Elson grunted and shook his head. "I guess the only thing I can do," he said slowly, "is to go and forget I've ever been here."

"And put an alpha-charge through your brain down the street?" hissed the old scientist. "Don't be a fool!"

The pilot flushed dully. "All right," he snapped. "What do *you* want me to do?"

A gleam of relief—satisfaction—approval came from the professor's eyes. An electrical tension in the air seemed to vanish like mist. Lorna drew a long breath, watching and listening to all this.

The scientist's answer was a question.



He wondered that the other planes paid him no heed——

"You have a ship, perhaps, over at the airport?"

"Yes, but in pretty bad shape. It'll take several days' repair work to make it halfway navigable again."

"Good enough." The old scientist drummed his fingers on the table a moment. Then he looked up. "You see, Elson," he explained. "I needed some one with nerve to help in this. When I laid eyes on you, something told me you were my man, even though you were of the so-called Other Side. That was why I wanted you to stay—wanted to talk to you. I've practically finished the anti-weapon—but now I need a demonstration. Mounted on a ship, the anti-weapon could be used over any certain battlefield and quickly prove its powers."

"I see that," grunted Elson. "But then what? One man can't stop a war like this one. There are a dozen major fronts and a hundred and one smaller ones. The anti-weapon, to stop the war as you hope, would have to be produced in quantity and mounted on a suitably armed and protected fleet of swift, powerful planes. One lone man in a small, half-ruined ship couldn't do more than cause a little talk."

"Of course, of course," said the scientist testily. "I'm not a crackpot egomaniac. My plans are this: I have drawn up complete blue prints and formulae for the anti-weapon—for any range and extent. These are to be delivered to the nearest headquarters of the Pacifist League. You've heard of them. In the early part of this terrible war they managed to put out circulars and create difficulties for the warlords. Most of them have been executed, but not the ringleaders. They escaped to the neutral regions of the north and are there trying to cause a universal anti-war movement. But of course the war-fever has not burned out and may not for another few years.

"Now suppose these formulae are delivered to the League. And suppose at the same time—lest they have human doubts—an incontestable demonstration is given of the power of the anti-weapon—you see? The Pacifist League will promptly take steps to create the very fleet and means you suggest for ending the war with the anti-weapon!"

Elson thought it over calmly and carefully. It was a long chance any way he looked at it. His ship might fold up. He might be shot down. The projector—though the professor had supreme confidence in it—might be a worthless thing—even dangerous. Yet none of these things mattered if it could truly bring an end to the chaotic war. Elson was suddenly sure of that, though yesterday he had killed a man without regret. Funny how he hadn't thought of that till now. Funny how humans followed a false god blindly, till they had a chance to get by themselves and think.

The scientist was looking at Elson with a deep pleading in his eyes. The pilot said nothing, but slowly drew off his heavy leather coat. "I'm staying," he said simply, when that was done.

IN THE next week, they began carrying out their plans. First Elson—with Lorna's help—pushed his light plane into an empty hangar, out of sight of prying eyes. Then the three of them began carrying parts of the anti-weapon from the laboratory to the hangar.

They were delayed then for three days when the sounds of aerial battle burst over their ears. They had to stay out of sight. Once they saw ten of One Side's aircraft drive back nine of the Other Side's planes directly over their heads. For secrecy's sake, they stayed in their laboratory-home.

"It's My Side's planned push," said Elson. He put no emphasis on the words "My Side." "Our military leaders planned to sweep into this sector. My commission—before I was brought down—was to spy on enemy gunnery north of this city. For all we know, we may now be in My Side's territory."

They heard the roar and hiss of infantry guns at the north end of the city for those three days, and then all became tomblike again, as befitted this corpse of a city. They went on with their work.

Elson went out foraging for food with Lorna when the restaurant supply gave out. Luckily, they stumbled on a tortuous entrance among heaped blocks of stone that led to what had been the bargain basement of a department store. There they found large stores of canned foods that ended their worries on that question.

The anti-weapon that Professor Davidson had built in his laboratory gradually took form on the nose of El-

son's ship. The pilot ripped out the wires that came from his battery supply —for his cabin heating coils—and ran them to the anti-weapon. This would give it the necessary small supply of electrical power to start its functions. After that its self-inductance coils would operate it independently. The batteries were charged from an auxiliary of the rocket motors.

Elson had repaired his ship as far as he was able. The left wing seemed staunch enough to hold up under cruising flight. The front rockets' jammed distributor yielded to his experienced touch. He patched the ragged holes in top and bottom of the cabin with the emergency cloth-tape. Of rocket fuel, gasoline, and solidified air cubes, he had plenty for an average cruise.

Everything was set. It was almost a month since Elson had landed at the airport with his crippled ship. It seemed like a dream at times—that he could be engaged in this almost fantastic venture. Allied with citizens of the Other Side. His every move a treason against His Side.

Elson made his way from the airport to the laboratory in his usual wary fashion. At times he had spied the figures of patrolling soldiers in the distance. It would not do to meet them and be questioned.

Approaching the basement door, he was about to give the usual cheery call when he heard the rumble of unfamiliar voices within. Elson shrank to the wall, pulling out his alpha-pistol. He crept to the door, put his ear to the crack.

"I warn you against resistance," growled a husky voice. "I have the official military warrant here. All able women are to serve as nurses at the north garrison. Come along, girlie."

There was an answering sob from Lorna.

"As for you, grandpaw," continued the gruff voice, "you better come along and explain what all that monkey business of yours is about. You may be hiding something."

There was a sound of scuffling and then another uncouth voice, "The captain says you come—so you come, young lady. We'll treat you nice—we treat them all nice, don't we, Cap?"

There was the sound of coarse laughter. Elson, shaking so hard with rage that his elbow beat a tattoo on the hard wall at his side, told himself calmly that there had been three voices laughing. Three armed men——

Elson straightened, stepped before the door, opened it soundlessly a couple of inches. Neither of the three uniformed men was turned his way, so for a few seconds he had a chance to see their positions and plan his next move.

He suppressed a gasp. The men's uniforms were of His Side! This sector and city had changed hands! Professor Davidson, directly facing the door, had seen it move, but gave no sign save a narrowing of his eyes.

Elson pulled the door open another few inches. This time Lorna saw it, gasped, and flung her hand toward her mouth. The soldiers whirled, just as Elson swung the door wide.

He triggered in a lightning motion, at the same time that he twisted and ducked. His alpha-charge tore squarely through one of the men, hurling him back as a corpse. The other private's return shot blasted over Elson's left shoulder. The pilot's next shot took him in the hip and spun him against the wall. The captain had drawn by this time and Elson knew he could not escape the shot.

An alpha-charge blasted—but it was the captain who fell with his heart drilled. Lorna dropped her smoking pistol and turned to her father's arms. A last charge hissed out from Elson's gun, taking the life of the wounded soldier who had been aiming for him from the floor.

Elson strode up to them, his deadly

fighting smile gone. "Thanks, Lorna," he breathed. "That took real courage. Don't feel bad because you've killed a man. It was them or us."

Lorna turned, dashing tears from her eyes, and smiled. "*You* were courageous, Dick. You killed them knowing they were men of Your Side!"

Professor Davidson muttered to himself. "Three lives to save millions. Not a bad bargain."

AS THE SUN sank, clothing the shards of a city in merciful gloom, Elson drew on his gloves and stood within the door of his cabin.

"Good luck!" said Professor Davidson simply.

"Au revoir!" breathed Lorna, but her eyes said more.

The tiny ship taxied down the runway and rose like a skimming bird. Within, Elson watched his lighted instrument board carefully. At times he glanced at the left wing anxiously, though he could not see more than its vague outline. It stood the test of the rise for a mile. Elson breathed easier. It was going to hold.

He rose steadily and at ten miles pumped fuel to his rear rockets—leveled out. The drone of the propeller stopped. Here in the rarefied stratosphere he did not have to worry about the wing. He scanned the surrounding skies continuously from his circular conning port. If ever he hoped not to meet a patrol, it was now. But not so much the enemy patrol—his own!

Two hours later frost had congealed in the cracks of his door and ports. The wires that should have connected to his heating unit were fastened to the strange looking instrument mounted at the nose of the ship. It was later to perform a hoped-for miracle. Elson stamped his feet and clapped his hands together to help his numbing circulation. He looked below for the lights of a city.

A thousand miles to the northwest he had come, to a region that had preserved strict neutrality. At the outburst of the Atom War, all old-time political boundaries had dissolved. The world had divided into two opposing branches of thought and aim. Certain isolated regions had withdrawn from the general mêlée. Inevitably they would be engulfed in the holocaust—but at present this city that Elson circled down upon was uncontrolled by either side's war-machine. The Pacifist League had a local station here.

Elson landed at the lake-shore airport. The officials questioned him and listed him as a deserter from His Side. He was escorted by armed guard to the League's post. The city was a curious paradox of armed pacifism. They expected attack and military occupation any time—from One Side or the Other.

Inside the large colonial-type building that housed the station of the Pacifist League, Elson had some trouble convincing them he must see their chief executive. He waited more than an hour for an audience with Colonel Stanton, chief of the post. At last Elson was ushered into his office and faced a mild-looking bald man with shadowed, worried eyes.

"Dick Elson," he read from the paper an attendant had left. "Deserted from His Side. Ace pilot arriving in low-wing single fighter. Very good. We can use you in our aerial defense. You will report to——"

"Never mind," interposed Elson. "I'm here on a different mission than just to escape the war. Look at these." He pulled a long, bulging envelope from his coat pocket and tossed it on the desk. Mystified, the official opened it and fingered the pages of drawings and typewritten notes. He looked up quizzically.

"A new weapon of some sort?"

Elson leaned forward, over the desk. "No, an *anti*-weapon! It was developed by a scientist over a period of ten

years. Briefly, it projects a field of force that allows no war weapon to operate within it!"

Colonel Stanton stared. "I'm not a scientist," he said slowly, "but frankly, I think it's impossible."

"Sure," said Elson dryly. "Listen! I have a small model of the anti-weapon mounted on my ship. I'm going somewhere in the Western Salient to-night and use it. If it works—you will hear of it, through the soldiers' grapevine. When you do, and are sure this isn't some crackpot stunt, pick up the inventor at the city I came from and rush him and those plans to your League's main headquarters. In the meantime—guard them with your life."

The official shook his bald head slowly. "You don't look crazy, but you talk crazy. But that's a fair proposition. Heaven knows, such an anti-weapon would be a godsend." The man's deep-set eyes shone with soul misery as he went on. "Mankind has gone mad in this terrible war. Civilization is crumbling. It must be stopped. Another year or two of this——"

He sprang to his feet. "We can't afford to ignore the least little hope. An anti-weapon—Lord!"

"My plane must be refueled, tuned a little," said Elson. "If you have a war-map, I want to pick out an important front. I must be on my way before dawn."

Colonel Stanton was already at his phone, barking orders.

DAWN spread a mocking red color over the bitterly contested Western Salient. For a week the two warring parties had hurled the cheap energies of the atom at one another. Troops had been fed into the maw of flaming, rending death in staggering numbers. One or the Other Side would buckle eventually, move back. A month later—when military movements had been completed—a new salient would materialize —then the story would repeat itself, most likely in reversal.

High above, a different Dick Elson than the one who had left this very war-torn spot a month before looked down and saw at once the pitifulness of it—and the maddening futility of it, and all its blundering lack of meaning.

He spied a plane, set his lips grimly. But it bore the same insignia as on his wings and after swooping close, darted away on some mission. Elson dropped his ship directly over the inferno of No Man's Land. He leveled at 5,000 feet and swung into an unbanked circle.

Heart beating, he snapped the switch that fed battery current out to the queer machine at the ship's nose. For a minute nothing happened, as the tubes warmed up. Then a faint shadow grew below the ship and darkened steadily. Five minutes later a cone of deep shadow extended from its apex at the nose of Elson's ship to the earth below. Its wide spreading base swallowed up the entire Western Salient.

Five minutes passed. Listening intently, Elson was able to detect that the low battle undertone was absent from behind the steady drone of his motor and propeller. He grinned exultantly. Down below *something* had happened. He wondered just what.

If he had been down there, he would have known. Men were cursing at the phenomenon that first darkened the sky and then made their guns cough and splutter. They did not know that a shroud of ultraspace had settled over them which drained the energies of their weapons. Officers stormed and raved, but the gun crews could not bring life to the projectors of subatomic artillery. In a sort of vagrant light that struck cold fear in their hearts when it did not change, the two warring forces faced each other in an impotent bewilderment. Later it began to get appreciably colder. It was only part of many strange, im-

possible things that occurred in that area——

This was not the laboratory projection of ultraspace—heatless, lightless, timeless, drained dry of energy, for in that men would have died, sightless and frozen. It was simply a light touch of ultraspace, but enough to cancel the fiercer energies of the atomic weapons, rob the sky of much light, and confound the fighting forces entirely.

Elson's ship circled monotonously, pouring down the shadow from the anti-weapon. Hours later, when his gas fuel ran out, he changed to the rockets. It was difficult to maneuver with this motivation in the dense air, but he stoically bore the strain of his death-grip on the stick.

He had feared eventual discovery and attack by craft flying outside the range of the shadow. But to his astonishment, several planes passed near him without seeming to notice. He remembered how it had hurt his eyes to look at the globe of ultraspace in Professor Davidson's laboratory. Perhaps, he reasoned, light was so strangely distorted near the shadow as to convey no recognizable pattern to human eyes.

Perhaps the whole thing was a dream, too. Dick Elson was not sure about that when—toward dusk of that day—he snapped off the anti-weapon and looked below. The battlefield was as peaceful and static as a drowsing countryside. He winged away, awed at what the instrument had done. To-morrow they might again be at one another's throats, but the day was coming when dozens—hundreds—of such cones of shadow would lay peaceful fingers on Earth. There could be no war, with the anti-weapon.

ELSON slanted down toward the airport for a landing, nose rockets flaring. The ruins of the city were limned against the stars. Two figures came out of the darkness, one of them petite. He thought of the latter's tender blue eyes and thrilled within himself. He leveled as the concrete loomed close and waited for the bump of wheels.

But strangely—there was no bump of wheels. Thinking he had lost his undercarriage, Elson tipped the nose down just a bit more in split-second decision. He would have to make a forced landing on the belly of his fuselage—— He waited tensely for the grinding scrape and a possible crack-up——

Then suddenly, he knew something was wrong. Something more than just a missing undercarriage. Past his eyes streamed a distortion that made no recognizable picture. But one thing struck him forcefully and his brain reeled. He seemed to be *under* the concrete runway and looking *up* through it, as though it were transparent!

Elson jerked the ship up sharply, feeding his tail rockets. Because he hoped it was a tired mind and stinging eyes playing him tricks, he zoomed up, circled, and tried again for the landing. He noticed now that Professor Davidson was waving his arms wildly and shaking his head. Somehow his pose had a forlorn air to it that sent burs of coldness down Elson's spine.

Elson lowered carefully, at almost stalling speed. He knew exactly when the wheels should touch. But they didn't. He knew exactly when the fuselage should touch. But it didn't. The ship continued sinking, as though the concrete weren't there!

And then, in a vague sort of way, Elson knew. He remembered that all day while he had circled above the battlefield, other planes had passed him by, as though he hadn't been there. As though he had been merely a ghostly sort of image which the passing pilots had credited to optical illusion—— Elson knew that was what they had

thought—because he himself had seen those *other* planes only as ghostly images!

And the city ruin that swept by him as he rose again—it, too, was but a phantom scene, tenuous and half transparent. He hadn't quite believed his eyes before. Professor Davidson and Lorna stood there like wraiths of another world, watching the wraith that was himself and his ship. Elson knew, with a chilling positiveness, that he would never be able to land at the airport, nor anywhere on Earth!

One thing bothered him now. Would Professor Davidson realize what had happened? Would he correct the error in his projector for the Pacifist officials when they arrived to take him to their factories? So that the anti-weapon would not send more pilots to this unknown doom?

Down below, Professor Davidson was saying, "The anti-weapon, draining away the energies of the battlefield, also drained away most of his substance, because he was so near it. He has been projected into that other space—into the ultraspace! I can correct it—add a grounding unit to dissipate that secondary drain. But I didn't know—and Elson—is doomed!"

With a little moan, Lorna drew into her father's arms. "I know, I know!" he said comfortingly. Then he watched the phantom plane as for the third time it came down, utterly silent. It came close and stopped, hovering somehow in that other space. Elson's wraithlike figure leaned out of the cabin, with a question on his face. Professor Davidson nodded. Elson saluted in understanding and glanced once at the sobbing girl, face drawn.

Then his rugged face grinned. He waved once and drew back into the cabin. Silently, the ghostly plane arose and faded into the dark night.

THUNDER VOICE

By

Dow Elstar

An idea of forgotten antiquity—remembered to save a world

"IN five hours we shall be dead."

Borsk Kamin looked with fevered eyes out of a window of the Terrestrial control-turret. The night was beautiful and terrible and still. The Moon, made gigantic and hideous by shrunken distance, filled the hollows of the arid landscape with rusty shadows.

Again Borsk Kamin whispered those few words which seemed irrevocably true: "In five hours we shall be dead. All of us. The entire human race will be wiped out. Even our corpses will be reduced to their elemental substances by a collision of worlds. The Moon and the Earth, born twins, at last shall be united in fiery, cosmic union. Millions of years of human history, hectic and glorious and sordid, are about to end at last in catastrophe inconceivable!"

Borsk Kamin, his body old and frail beneath his immense bald pate, stood in the turret beside the great gravity coil. The youths—sixteen of them—were impassive behind him, their pinched faces white with strain. In their huge, limpid eyes—a minor development of countless ages of evolution—were gleams of mingled pity and awe for their ancient teacher. Pity and awe which was, perhaps, combined with a trace of contempt. He had been so sure that calamity could successfully be warded off—yet he was now forced to admit defeat.

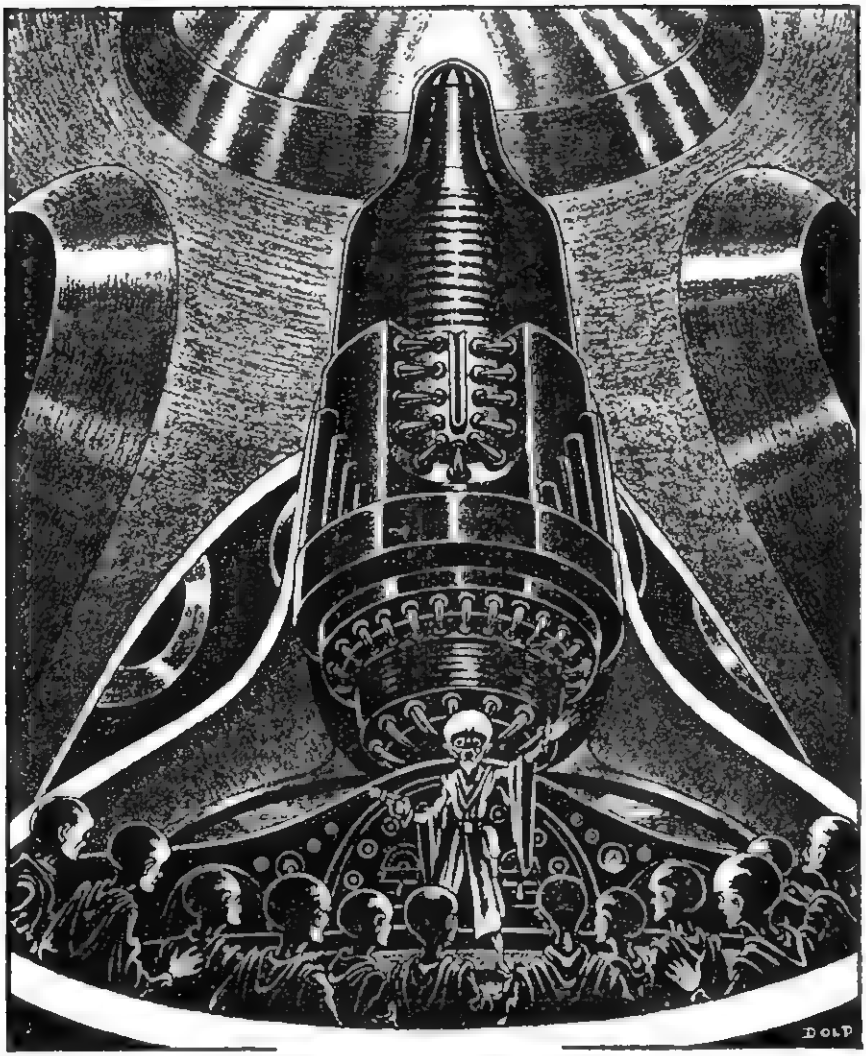
Jon Elan, brilliant young physicist, spoke up soothingly. "It was decreed from the very beginning, master," he said. "The planets and the satellites of planets are slowed gradually in their orbits by tidal friction. The centrifugal force which keeps those orbits wide, decreases, causing their diameters to wane. And so, finally, the collision of moons with the worlds they circle and the falling of the planets themselves to the dying Sun which is their mother, is inevitable. Perhaps, then, we should accept our fate calmly. Those forces which dominate the movements of worlds were perhaps meant to be always beyond our control."

A few of the youths nodded resigned agreement. Others remained stolidly motionless.

For a moment Borsk Kamin was inclined to accept what seemed the decree of destiny calmly. After all, his race had made splendid efforts to survive. Vast underground cities had been built, tucked away in the warm crust of the Earth, safe from the effects of the thinning upper atmosphere and the failing warmth of the Sun. For a million years, now, life had been happy and secure in those cities. Maybe——

And then old Borsk Kamin's hardy spirit regained its ascendancy. He felt like cursing and screaming. For once his quiet self-control evaporated.

"The unsolved problem which changes success to failure seems so simple—so stupidly simple!" he burst out. "Everything moved smoothly until it came



"Back," he snapped. "Insane or not this method alone offers hope!"

up. I invented the first gravity coil soon enough so that it might be used effectively. The production of others was swift and efficient. Scattered over the surface of Earth we have ten thousand gravity coils like this one here. Those on what is now the Luna-ward hemisphere are trained against the Moon —their gravity beams acting repulsively in reverse. On the Moon there are a thousand other coils, similarly active. There is enough power to arrest our satellite in its fall—enough power, even, to force it back gradually into space! But we lack one vital thing—a means of coördinating our operations with the

operations of the coil crews on the Lunar surface! We are failing now only because we cannot communicate with the Lunar crews. To tell them just what they must do is absolutely essential, for our task is complicated indeed. We didn't foresee that strains and warps would be set up in the ether by the unbalanced condition of two worlds—strains and warps which distort hopelessly the trans-spacial waves of our radio transmitter."

BORSK KAMIN glanced wildly at the meters and instruments around him. Connected with these devices were mechanical calculators which, in a moment, could compute the exact angles at which forces must be applied and could determine the required strength of those forces. This vital information depended on factors too minute to be forecast far ahead. And now it could not be sent to the Moon where it was needed so desperately.

"There must be another way!" Borsk Kamin shrilled.

Jon Elan shrugged. "There is none, master," he said. "We could not use light-signals, even though they would not be distorted nearly as much by the ether-warps as radio-waves. Simple code messages given in the form of light-flashes would be too clumsy and too slow. Speech, modulated on a beam of light as photophonic impulses, might be effective, but there is no suitable receiver on the Moon. There is not time for us to take one there, and not time for the Lunar crews to construct one.

"Of course a few of our people might choose flight toward Mars or Venus as a means of reaching safety. But no preparation has been made for an extensive exodus, and in a scant five hours how far could the refugees get? When Luna and Terra meet, space for half a million miles around will be filled with fire and flying debris!"

Borsk Kamin didn't reply immediately. He stared again from a turret window, out into the eerie night over which that monster, pockmarked disk hung threateningly. It didn't look much different, or much larger, than it had as far back as old Borsk could remember. But this was natural. Normally, changes in the orbits of worlds are slow indeed. It is only when a condition of definite unbalance is reached that things happen with tremendous swiftness. Borsk knew that within the next several minutes the Moon would really begin to fall, spiraling down around the Earth like an inconceivable juggernaut —accelerating to a speed of many miles per second.

And then the old scientist saw things which were not within view. In his mind's eye he was looking into a museum in one of the buried cities, a museum which he had visited often during his childhood. In a glass case in one corner was a small, black device, sawed in half longitudinally to reveal its inner structure. It was an early telephone receiver, made during the Twentieth Century, millions of years ago.

With sudden swiftness, Borsk Kamin's thoughts coalesced to form a mad, yet simple idea. He acted on it at once. His hand darted to a switch at the base of the great gravity coil to jerk it open. The black, cylindrical bulk, pointed defensively at the Moon, was now inactive. No slender, tremendously powerful beam of reversed gravity—created from atomic power—stabbed up from its muzzle now, to brace the wabbling Lunar bulk. The luminous energy dome, which formed the roof of the turret and served to confine within it air dense enough to breathe, no longer bulged upward under the savage thrust of that beam.

Borsk's act startled his companions. To do what he had done seemed against reason. Was the old master losing his mind?

"Best to restore the coil to activity again," Jon Elan advised with quiet restraint. "To leave it as it is only served to weaken Earth's available defenses."

Borsk Kamin's withered lips curled. "No!" he said. "One less gravity beam, among so many, can make scant difference!"

Fiercely the old savant clawed at the metal cover which shielded the delicate control apparatus of the great black cylinder. He lifted the cover. Groping within, he first turned a boss. For an instant, as if for a test, the coil was active again; but this time its beam attracted rather than repelled. Now Borsk seized tools lying near by, various standard equipment available in the cabinets along the walls.

Jon Elan and several others moved nearer to the ancient one, speaking in soothing tones. But he was wary. From the pocket-pouch in his harness he jerked out a pistollike weapon.

"Back!" he ordered harshly. "Insane or not, I am still your master. You will do only that which I command!"

THERE WAS a central control-turret on the Moon, just as there was on Earth. In that turret was located the radio apparatus that had proven useless.

Around the gravity coil there a dozen silent men stood calmly and hopelessly. In the black sky above them hung the colossal crescent of Earth, orange and arid and grim. Beyond it and off to one side was the shrunken, red Sun. Those men knew what the circumstances were and they expected no miraculous stroke of luck—there could be none.

Then out of the silence of their own dejection, a great voice boomed: "Borsk Kamin calling Lunar control-turret! To your posts for action!"

No moment could be wasted in an effort to probe out the essence of the wonder that was taking place. The men acted automatically, and with perfect discipline. But the curiosity in their minds—minds trained for observation and deduction—could not be entirely suppressed.

They knew that between themselves and Earth—where Borsk Kamin now was—there was a shrunken, though still vast gulf. That gulf was a vacuum through which sound, in its normal form at least, could never be transmitted. They knew, too, that all around their refuge, except for the scattered turrets occupied by the other coil-crews, there was nothing but the stark terrain of the Moon—as airless as space itself.

And they knew that the voice they heard was not issuing from their radio-speakers. The solid metal floor under their feet, the very substance of their bodies themselves seemed to tremble with its ponderous tones. The luminous energy shield—airtight and elastic—that roofed the turret fluttered with the heavy vibrations. For the present, the men must simply accept fact as fact.

"Rebroadcast the following to all Lunar turrets!" came the thunderous order and Reus Karro, radio operator, hunched ready at his post. As on Earth, wireless communication was still possible over the surface of the Moon, for it was only in the void between the two spheres that the obstructing ether warps existed.

"Lunar turrets 1 to 70 direct gravity beams at angle 96.4, standard," growled the magnified voice of Borsk Kamin. "Make corrections of angle for individual positions on Lunar globe. Repulsion force at full. Turrets 71 to 150 direct gravity beams at angle 43 standard, with similar corrections. Repulsion force at 87 percent. Turrets 151 to 300——"

Thousands of men in scattered refuges on the Moon's crust moved and began the battle with a cosmic nemesis successfully now, for coöperation with their fellows on Earth had been made possible.

Two days later—long days, for

Earth's axial rotation had slowed gradually through the ages—a gigantic celebration was in progress in the cities buried in the crust of Terra. In spite of mental advancement, mankind had not lost its love for gayety, noise, and carefree excitement. The Moon would not fall; it could be held at bay forever. It could even be driven back into a stable orbit in time. And so mankind rejoiced.

REUS KARRO, relieved of his post, had just come in from the Lunar control-turret. He had proceeded at once to Sadu, his native city. There he looked up Jon Elan, friend of his student days, who had also been relieved of duty.

"I'm afraid I haven't a very clear idea of what Borsk Kamin did to produce that thunder voice of his," Reus Karro complained. "As a matter of fact, every one seemed so busy that no explanation was sent to us on the Moon."

Jon Elan smiled sheepishly. "I thought the master mad," he admitted. "But his inspiration was scientifically sound in every respect, and very simple. You know how an ancient telephone receiver works—one such as the primitives of the era known as the Twentieth Century used? Our sound-receivers are somewhat different now, and of course much more refined—but that old-time device is a perfect, if crude analogy of the principles which Borsk Kamin employed!

"A receiver of that ancient type contains an electromagnet, whose strength is varied, or modulated, by the varying electrical impulses from a microphone. Thus the electromagnet's uneven pull causes a metal diaphragm to vibrate, reproducing sound waves originally picked up by the microphone.

"The principles involved in what Borsk Kamin accomplished differ in only one major respect from those of this analogy. Instead of magnetism, he employed the similar, though much stronger and more far-reaching force, gravity! That was affected scarcely at all by the ether warps.

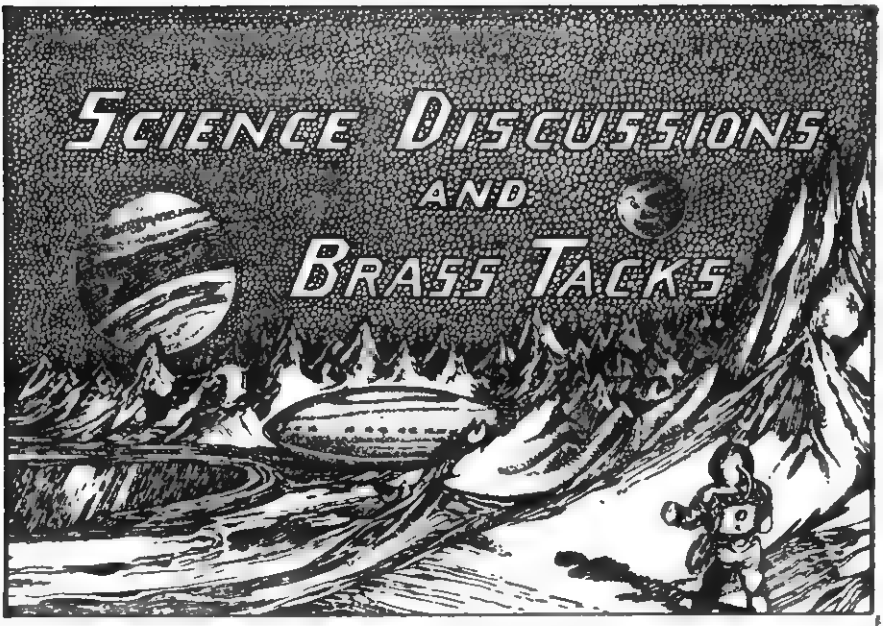
"Kamin shut off the gravity coil in the Terrestrial control-turret. To its controlling apparatus he attached a microphone—one of the modern type, of course, though parallel if not identical to the ancient, and more effective. Then he turned energy into the coil, having set the latter for attraction, though repulsive gravity would have worked as well. He spoke into the microphone and the strength of the gravity-beam varied, receiving the modulations of his voice. The modulated beam, groping across space, touched the Lunar control-turret and caused its walls, its floor, the air inside it, and the very flesh and bones of its occupants to vibrate with the sounds of his words, just as the diaphragm of an old-time telephone receiver would be vibrated by its electromagnet! Do you understand?"

Reus Karro nodded, awe written on his face. "We should build a monument to Borsk Kamin, the Ancient," he said simply, "and to those more ancient ones who inspired him."

The Department of Prophecy—

In Times To Come

Page 4



Future Evolution.

Dear Mr. Campbell;

There appears to be a remarkable variation in the opinions of the various science-fiction authors as to the probable rate and direction of evolution of *Homo Sapiens*. Some of them project themselves blandly ten million years into the future, and discover men indistinguishable in all but their clothes—if any—from the men of today. And others, with equal *bonhommie*, evolve man out of all recognition in fifty thousand years. You pays your money and you takes your choice. And what they evolve the said men into! Some—smelling faintly of H. G. Wells—evolve man into a brain and a mass of tentacles—some turn him into a lotus eater—some give him a handful of news and astounding senses—and some, believe it or not, make him act intelligently!

To all of which one may say, "Interesting if true." Those who just don't evolve him at all show not only a commendable caution, but their ignorance of the fact that only animals like the lowly octopus, the over-rated termite, and the ever-present cockroach have ceased to evolve, being perfectly adapted to their environment, and so thoroughly specialized that further adaptation is blocked. Remember, always, that perfect adaptation through complete specialization means the end of evolution for the species in question. The saber-tooth tiger was one example, and the horse is probably another. They're just too good. However, a relatively unspecialized animal like the rat, or the bear, or Man, has a beautiful opportunity for further change.

Those who evolve Man into a miracle in fifty thousand years forget the deadly slow rate of evolution. Remember, Pithecanthropus probably appeared 10,000,000 years ago, and the first modern man (by that I mean a member of our own species, *Homo Sapiens*) at least 1,000,000 years ago. The Cro Magnon man—indistinguishable from us in all significant respects—is practically a contemporary. He probably showed up no more than 50,000 years ago.

So, though further evolution of Man is highly probable (assuming that he hasn't killed himself off before then) the rate will not, in all probability, be very high. Whether the rate of evolution is greater now than it was a million years ago, we don't know. But assuming that it is the same, it is probable that Man will be perceptibly different from the present species in half a million years.

As to the direction that that evolution will take—one man's guess is just about as good as the next man's. Probably they're both wrong. Evolution apparently depends on the slow accumulation of haphazard mutations, caused, perhaps, by the cosmic radiation. If the mutation is a detrimental one, the organism will probably die or fail to reproduce. If good, the chances are that it will live and multiply. We do not adapt ourselves to our environment—our environment kills off those that aren't adapted to it. But, again assuming that mutations occur that adapt ourselves more closely to our environment, what will the eventual result be?

Most of the authors assume that Man will become more intelligent. That may occur in one of two ways—the brain may become larger, or it may be used more intensively. The latter appears more probable, since if the brain grew larger, without a corresponding mutation to increase the size of the skull, the results would be sad, to say the least. A race of neurotics with continual headaches wouldn't last so long. But, the brain at present is not used at anything like full capacity, and there's plenty of room for improvement there. What a race would be like that thought five times as well, or as fast, or as brilliantly as the present one, no one can imagine. It might spend all of its time worrying about problems that we haven't even heard of. On the other hand, it might not—it might make this world a place fit to live in.

Some authors imagine that the men of the future will be weaker physically than the present men. Maybe—but at least during historical times, Man has been getting steadily larger. A modern athlete can't get into the average suit of armour you find in a museum. Some assume that machinery will do so much that Man, reduced to pressing a button, will become a physical weakling, traveling in a wheel chair. That assumption is based on the further assumption that our present machine civilization will continue indefinitely. Well, if it does, it will

be acting differently from the fifteen or twenty previous civilizations that have grown, flourished, and crashed. One short return to barbarism would eliminate the physical weaklings in a hurry.

What our eyes may evolve into is anybody's guess. One prominent physiologist—whose name I have forgotten—hypothesizes that eventually Man will become a Cyclops, with one huge eye above the nose, but with two pupils to retain binocular vision. Extension of the visual range into the infra-red and ultra-violet would be definitely useful, but we'll have to hope for a useful mutation.

Improved dexterity with the fingers, and perhaps longer and more slender fingers, are of definite value in a machine civilization, but whether we'll get it depends on the mutations again. Until, of course, we learn how to control the mutations ourselves. Then—all bets are off.

Finally, there is one something—maybe it's a sense, maybe it isn't—that may evolve in course of time. I refer to clairvoyance and telepathy, lumped as Extra-Sensory perception—or ESP—by Dr. Rhine, who has investigated them at Duke University. His experimental results are remarkably good, and if what he is working with is the beginning of a new means of perceiving the world around us—well, I, for one, don't care to predict what the end-product will be.

So here's the final result of my cogitation—partly probabilities, partly wishful-thinking. In a million years or so Man will be larger, averaging perhaps six and a half or seven feet tall. He will be much more intelligent, making mental solutions of the three body problem. He will be able to see ultraviolet and infrared, and to see with much more detail than at present, due to an increased number of cells in the retina. His fingers will be perhaps twice as long as the present ones, with infinitely flexible joints. He will be quite capable physically, cleaned out as he will be, of the vestigial remains such as the appendix that clutter up our internal economy. And finally, he will be able to communicate telepathically with his fellows at will, and will be able to *know* the universe around him without the intervention of his other senses. But, he will still be a man, recognizable as one. Control over human heredity will very probably accelerate evolution to a considerable degree. As for the direction, as I said before—all bets are off.

If anybody has any ideas on the subject, let him bring them forth. Destructive criticism will be available in unlimited quantities.—John D. Clark (Ph. D.), 3809 Spruce St., Philadelphia.

Vision and Mind.

Dear Editor:

In the December issue of the magazine there appears an article entitled "Spectral Adventurers", by Mr. Herbert C. McKay. On page 52 Mr. McKay states: "There is no light, no sight, no vision outside the human mind."

For a moment let us go back to elementary optics or physics. You can only see an object because of the light reflected. Therefore, if light does not exist, it is impossible for us to actually "see" anything. Everything is a product of the imagination. All right, I'll concede that much! But, a person who has been blind all his life and to whom sight has instantly returned can see! If a person has never seen light, and light does not exist, why is it they can perceive objects?

Another thing! If I pick up a magazine and thumb through it, and if everything is imaginary, why is it I can see the same advertisements on the same pages as my brother?

If Mr. McKay is correct, we should be able to see different advertisements on the same pages.

I hope this comes to the attention of Mr. McKay because I'll appreciate an answer to these questions which are not clear in my mind. —Louis Koenigsberg, Jr., 651 Linwood Avenue, Buffalo, N. Y.

The error was typographical.

Dear Editor:

In the Brass Tacks column, page 159, December issue, Mr. Lester J. Rose makes the remark that authors should look in "Handbook of Chem-

istry and Physics". When he (Rose) does so, he should be more observant. The formula for Ammonia gas is not NH, but NH_3. When combining with other substances, it acts as a radical and the formula then is NH_4. (For instance $(NH_4)_2SO_4$, Ammonium sulphate.) I hope you either print this or forward it to Mr. Rose. Thanks for listenin'.—Don Gunn, 1615 13th St., Oakland, Calif.

Light on the subject.

Dear Editor:

After seeing some of the discussions in Science Discussions, I felt obliged to put in my two cents and help solve some of the mysteries confronting your readers. For one thing, I didn't care very much for some of the things in the letter from Frank Bochik. In the first place, light is not matter in the free electronic state nor is it true that light is affected by gravity. I admit that the light from a star is bent when it passes close to the sun, but I do not admit that gravity directly causes it. Einstein, who predicted the effect, claims that it is due to the distortion of space by the great mass of the sun. This distortion is his substitute for gravitation and, as it is space itself that is warped, everything in space is affected—including light. This is why Frank's statement is incorrect. To refresh his memory, it ran as follows, "Light, being affected by gravity, is matter in the free electronic state".

I am afraid that I will have to pick on Frank a little more, this time because of his statement in which he said that if a luminous body exceeded the speed of light, the light which was generated would not precede the body but would trail along behind. Light, being rather peculiar, will do no such thing.

I will try to explain this. It is an extraordinary but proved fact that all observers, however fast they may be moving, find the same value for the velocity of light. The most careful test of this statement has been made in the famous Michelson-Morley experiment. It is easy to see what this strange result means if we think of a bird flying from one end of a train to the other (on the outside). If the train is at rest the bird takes a certain time for the journey. If the train is moving toward the bird it takes a shorter time; if the train is moving away from the bird the bird takes a longer time. Here everything is as it should be. But Michelson and Morley found that if a ray of light, instead of the bird, is the flying thing, it takes exactly the same time in all three cases. Einstein's theory completely explains this. We are measuring the distance flown and the time taken from the train. According to the theory time and distance vary with motion. Moreover, they vary to exactly the extent required to produce complete compensation, so that in each case the measured velocity of light will be exactly the same. This remains true however fast the train is going. This means that an observer on the luminous body would find that the light preceded the body, going 186,000 miles a second faster. An observer in front of the body, if he measured the speed, would find the light pacing along at the regular velocity. In other words, it's all a matter of relativity. Incidentally, this same explanation applies to a similar fallacy in the letter of William Danier.

Perhaps I can help Earl Sharland who seems to be confused over the velocity a ship needs to clear earth's gravitational field. The velocity of 7 miles a second applies only to those ships that have to leave earth by being given one great push. Jules Verne's classic ship is an illustration. A ship that has its own power plant and can use it continually is able to leave earth at any speed.

I guess this is enough for one letter.—Paul Gaumond, 402 W. Woodruff St., Watertown, New York.

Slow-speed Spaceship.

Dear Editor:

Of the many interesting letters in the December issue, two call for comment. Mr. Earl Sharland asks why a spaceship couldn't take off from Earth at a very low speed and keep this speed until it was outside the influence of Earth's gravity. He wants to know why it is commonly assumed that a spaceship must start off with a velocity of six or seven miles a

second. Well, Mr. Sharland, you are right and all the others are wrong. I have noticed that readers and authors alike glibly talk of the velocity of escape—seven miles a second—without really understanding what it means. To understand it requires going at the problem backwards, thus:

Suppose a body fell to Earth from a very great distance, an infinite distance, under the influence of gravity. It can be shown by the use of integral calculus that the body would arrive at the Earth with a speed of seven miles a second—the velocity of *arrival*. Now it is common knowledge that if you throw a body up into the air with a small velocity, it goes up a small distance, then falls back. If you throw it up with a large velocity, it goes up a greater distance, but still falls back. If, however, you could throw the body up with a velocity of seven miles a second, it would never fall back! It would keep on going forever, slowing down because of the backward pull of Earth's gravity, but it would never stop and fall back. This is what is meant by the velocity of *escape* which is equal to the velocity of arrival!

In the case of a spaceship, since the ship carries a supply of energy with it, it can start with any speed, however small, and travel any distance, no matter how large, merely by taking as much time as required for the trip.

It has been said that those who know the least are the most positive in their opinions. Mr. William M. Danner is a fine example of this. He admits he hasn't "read" the Einstein theory, yet he presumes to explain purely mathematical concepts with words. If he had read the relativity theory, and understood it, he would know *that the speed of light is entirely independent of the velocity of the source*, and that, therefore, in all three cases he discusses, light would have the same speed, 186,000 miles per second. How is it possible that light should move with the same speed when the source is approaching as when it is receding? Well, read the relativity theory and find out. And that isn't all. Read about the Doppler effect in light also.

In fact, I wish to recommend the following to any one who wants to talk with authority about relativity. Go to a good college, study Optics, Mechanics, Thermodynamics, Electricity, Radioactivity, Spectroscopy, Atomic Theory, X-Rays, Trigonometry, Analytic Geometry, Differential and Integral Calculus, Differential Equations, Theory of Functions of a Real Variable, Theory of Functions of a Complex Variable, and at the conclusion of all that, you may then be ready to *begin to study* the mathematics of Riemannian and other non-Euclidean geometries which you must know to understand the first thing about relativity and modern physics in general.

All these books that pretend to explain relativity in words are plain fakes. They can't do it because relativity and all modern physics can be expressed only in mathematical symbols, not in words. All they can do is explain the relativity of motion—the least important part of the special theory of relativity. When they try to explain the "separation" of events, they begin to totter. When they get into general relativity and the curvature of space and the bending of light they fall flat on their faces.

And you, Eando Binder! How could good authors like you commit such an awful story (?) as "The Time Contractor"? Was there *anything* right in it? I couldn't find it if there was. Example: Page 146, column 1, paragraph 5: "When a planet warps space it exerts a power of attraction—which is energy." Oh, Newton! If you could but see this! Binder doesn't know that force, energy, power are entirely different things. The force of gravitation (warped space) is a *vector*, energy and power are scalars. Does that mean anything to you, Binder? Energy is a quantity, power is a rate. Does that mean anything?

Again, same page, same column, paragraph 3: "When you increase the speed of an object, you use energy." Right! But next sentence: "When you decrease the speed, energy is again expended." WRONG! ABSOLUTELY INCORRECT! When an object slows down, energy is NOT expended against the object, it is expended *by* the object. See any text and learn something, Binder.

I could add at least ten more serious errors in the same story, but why extend the sad list? Poor Newton! Poor Einstein!—John James Logue, 152-25 136th Avenue, Jamaica, New York.

Heavy-star matter.

Dear Editor:

In response to the letter of Earl Rice in your December issue, here is something of an explanation.

Rice couldn't understand why a sample of the gaseous envelope of Keifer's star, while weighing tons at earth-gravity, would not include elements in addition to the 92 already discovered.

Since 1920 a considerable amount of research has greatly changed the classical Bohr theory of the atom. Today atomic physics embraces such an explanation of the atom as wave mechanics, a picture which is almost purely mathematical. At best, a pictorial representation of the atom is illusory. Nonetheless, the most satisfactory explanation (at least for me) of the "atom" on Keifer's star is nothing more than a consideration of the building blocks of the atom suggested recently by physicists to explain atomic phenomena.

All matter is composed of minute particles of electricity. These particles have attributes of size and charge. They have other attributes, but for convenience, let us consider these particles merely as charges of electricity. Their mass may be likened to mass as we know it; that is, the mass of Newton's first law, the mass which resist change of direction of motion or acceleration. This mass actually is the potential of the particle, for the greater the potential of a particle, the more it is affected by the fields of neighboring charged particles. Two particles of equal charge (not necessarily *like* charge) have masses inversely proportional to their size. The electron and proton then, having equal but opposite charges, are different in mass by virtue of their difference in size. For convenience again, let us consider the proton and electron as spheres of electricity. Experiment tells us that the potential of a point on a sphere is V=Q R, where V is ergs per e.s.u of charge, Q is e.s.u. of charge, and R is the radius of the sphere in centimeters. Since the proton is heavier than the electron, we may assume the proton to be very small in comparison with electron. The mass of both particles has actually been measured (by the mass-spectograph), the negative electron being 1/1840 or 0054 times as heavy as the positive proton. As you probably know, the proton has a weight of 1.0073 on the scale of oxygen 16.

There are other fundamental building blocks: the positron, similar to the electron but positive in charge, the neutron of probable mass 1.006 but without charge. Also the x-particle, announced last week by Dr. Anderson. It has a mass approximately 130 times that of the electron. The exact relationship of these last two to the proton and electron has not yet been determined. The neutron may be a proton and an electron bound together (as the probable mass of the neutrol suggests according to the packing effect) or the proton may be a neutron and a positron. Suffice it to say that these blocks fall into the patterns of the 92 elements.

That there are more than 92 elements is suggested by Bohr's progression of orbital electrons in the various energy levels—2, 8, 18, 32, 18, 8. Still more significant is the radioactivity of all elements of greater atomic weight than 210 (which is usually an isotope of lead, the isotopes of lead extending from 203 to 210). This fact indicates that above 210 atomic nuclei are unstable. Perhaps at one time, atoms of greater weight than uranium, the heaviest element weighing 238 14, existed, but have long since disintegrated. It seems improbable in view of the preceding evidence.

As for the "atoms" of Keifer's star, they are not truly atoms as we know them on Earth. The star is composed of the blocks of matter described above; but in vast gravitational fields like that of a heavy star the very forces of these particles are rendered inoperative as far as the formation of ordinary matter is concerned. There is no such thing as an atom consisting of a nucleus and planetary electrons on this star. Proton and electron alike are jammed together in a lump of, shall we say, pure mass.

A tennis ball filled with the substance of Keifer's star and transported instantaneously to the Earth would violently form matter as we know it, matter consisting of the 92 elements. Under the comparatively mild gravitational

force of the Earth, like charges of electricity would no longer remain in such proximity.

Spectrum analysis of Keifer's star would yield no results indicating new elements—or shouldn't. Spectroscopy is based on the arrangement of orbital electrons. When an atom is excited—i. e. when an electron moves under impulse from one energy level to a lower energy level—the atom acquires potential energy. The return of such an electron to its former position is accompanied by the emission of a photon of electromagnetic wave motion. The only variations in spectroscopic data as far as atoms themselves are concerned might be in a slight displacement of energy levels due to the abnormal conditions on the star.

Mr. Rice also asks why readers go to scientists for ideas. One reason is that the scientists' job is to explain, as plausibly as possible, what he observes. He is not necessarily right, but if he offers a better explanation than anyone else, it is for the time being accepted. It is foolish to believe that, because what a scientist suggests does not sound plausible, the scientist is "off somewhere". There are so many complications in modern physics, so many different aspects or phenomena which a theory must embrace, that what at first seems least likely is in the long run most plausible. Furthermore, the ever-increasing part played by mathematics in physics and chemistry makes it almost impossible for any but a higher mathematician to understand, much less criticize, modern theory. When Thompson, Davis, Jeans, and the rest present a theory, you can be sure they have good reason for so doing.

I've done this in a hurry, but you get the general idea. Let me know if I've slipped up anywhere.—D. C. Beere, Cadet, U.S.M.A., West Point, New York.

More dimensions.

Dear Editor:

Some more about the "mysterious fourth dimension": Frank Bochik, Jr., I think, has the right idea. His tesseract is really a work of art, and quite recognizable, although departing somewhat from the usual representation. However, a request: Will Frank please draw us a picture of a cube and do it using only *one* dimension? Then perhaps he'll realize the difficulty of getting his ideas across by means of a two dimensional picture of a three-dimensional picture of a four-dimensional object.

Mr. de Camp delves into definition and tells us that a dimension is *any* measurable quantity. All well and good, but isn't the matter capable of further dissection? The argument, if I am not mistaken, is about *geometric* dimensions; length, width, thickness, and the "mysterious fourth", all mutually at right angles. If we consider the *physical* dimensions of length, mass, and time, the conception is entirely different. We don't accuse length of being perpendicular to mass, do we? As for the pineal gland and Popeye's Jeep, the term "dimension" is admittedly used loosely, therefore why not be more specific and avoid irrelevant generalities?

The "narrow-minded" Mr. Loomis, I fear, has missed the point of the discussion entirely. Neither a drawing nor yet a solid model of a tesseract is supposed to be an actual four-dimensional object. The model is simply a three-dimensional *projection (not* a cross-section) of the supposed four dimensional body.

The existence or non existence of higher dimensions of space (excluding the relativistic concept of space-time) is purely speculative—mathematical science-fiction as a correspondent so cleverly put it a few months back. However, multi dimensional geometries are real enough as real as any other branches of pure mathematics. The mathematically inclined can, therefore, perform their mental gymnastics in four dimensions, or in forty if they have the patience.

William M. Danner applies common sense to the problem of the velocity of light, but neglects his Einstein whereby he falls into error. Relativistic "common sense" is quite as logical as the garden variety, and its prime assertion is that the speed of light is constant, regardless of the motions of source or observer. Both, being in motion relative to one another, have their own peculiar notions as to what constitutes their "proper" time, size, mass, etc. The result

is disagreement on nearly everything except the fact that the velocity of light is 186,284 miles per second in terms of their own "proper" miles and seconds. Therefore the analogy of the moving train does not apply.

Infinity still seems to be giving a little trouble. Minus infinity seems a poor antonym for plus infinity. It's still the same old "infinity". The direction is changed but the meaning is the same. Elton Andrews' "infinitesimity" is quite synonymous with the "zero" of mathematical analysis, though not with the "zero" of arithmetic. The zero of arithmetic is the absence of quantity, while the zero of analysis is a quantity "smaller than any assignable quantity, however small". The difference here is simply one of definition. What the actual difference between the two zeros may be is a question for the philosophers.

Incidentally, here's an odd slant on the question of quantities beyond infinity. Ought not imaginary quantities be considered *less* than minus infinity? We are told that only positive numbers can have logarithms. Thus the logs of all numbers greater than +1 are positive numbers, the log of +1 is 0, while the logs of numbers between +1 and 0 are negative numbers, down to 0 whose log is minus infinity. However in texts on trigonometry we find the statement, due to Euler, that *—1 has a logarithm* (to the base *e*), and that it is equal to $i\pi$ or $\sqrt{-9.8696}$, an imaginary number. Mathematically this is expressed as $e^{i\pi} = -1$ or $\log_e(-1) = i\pi$. $i\pi$ is the log of a number which is less than 0. The log of zero is minus infinity, therefore $i\pi$ is, in a sense, less than minus infinity.

And finally, to Earl Rice who is concerned about the contradictory statements of scientists. The extremely dense "star-stuff" referred to does not (supposedly) contain any unknown elements. It is simply ordinary matter, the atoms of which have been stripped of their "planetary" electrons by the high temperature and the nuclei forced together by the extreme pressure into a densely packed state. At the high temperature of the star's interior this matter is naturally in a gaseous state. The criterion of a gas is not its density, but rather its ability to expand when the pressure is reduced, hence extremely dense gases are not anomalies. The spectral lines whereby the elements are determined are caused by the planetary electrons of their atoms. Under the extreme temperature and pressure, these electrons are separated entirely from the atoms and the identifying lines are therefore, not seen, and only a continuous spectrum results. This stripping of atoms down to the core, so to speak, represents a degree of ionization as yet unattained in earthly laboratories. Gases when strongly ionized, which represents a partial removal of the electrons, show corresponding changes in their spectra.

For "Brass Tacks" my appreciation of Schachner's "City of the Rocket Horde", a truly outstanding story.—Norman F. Stanley, 43A Broad Street, Rockland, Maine.

BRASS TACKS

Do Readers want longer story-headings?

Dear Editor,

So Brass Tacks is back again from "Beyond Which Limits" (Schachner) Excellent! Now we can have some of those old fashioned controversies, old-time brickbats—and letters by the "old gang" of science fiction which have been missing so long. Here are some tacks for you to swallow:

The stories are too short, far too short. Even the serials are divided among too many issues (deny it if you dare!) and there are too many short stories. Oh, there have been many superb shorts, I will admit; witness "The Phantom Dictator", "Man of Iron", "Beyond Which Limits", and—more recently—"Mana"... But please—fewer stories and longer ones. Schachner writes acceptable short tales but is rather cramped there. Macfadyen is wonderful sometimes and boring more often. Winterbotham is tops (although his stories are too similar). Give us more Williamson yarns and Van

Lorne masterpieces (and a Wesso cover); keep the stories scientific and accurate. And—ye gods!—keep the title "novel" away from novelettes, regardless of plots. Now a story like "The Galactic Circle" is really almost worthy of that misused title. The headings for the tales are too alike. The few words, interspersed by dashes, read like spurts from a disintegrator.

I won't bore you with demands for the large size, quarterlies, and the like; you are doing your best and we'll get them when the time is ripe.

Now for some gold-plated tacks. The best 1937 story (not counting Smith's masterpiece, of course) was "At the Perihelion", by Willey, closely followed by "Beyond Infinity", by Corbett, "Past, Present and Future", by Schachner, and "Dark Eternity", by the redoubtable Fearn. Cream of a rich crop!

Please make Smith write more often (oh, for the "Skylark" days—and Hawk Carse). Schachner's "Past, Present, and Future" stories are up to his "Redmask" fantasies and "Entropy". Fearn is much better than in the "Mathematica" days (thank the cosmos!).

I believe the future of science-fiction is up to our magazine. Only you can hope to equal and surpass the glories of the past; a great responsibility, but a deserved one. I've been following you for a long while in my spaceship, and the future will find me still with you among the galaxies.

Let's have a concerted drive by science-fiction fans against the ridiculous comic strips that are a travesty of science-fiction—and for a cleaner, more scientific science-fiction field.

Lest some of these compliments have turned your head, Mr. Editor—here's a final tack:

Lovecroft is gone; "At the Mountains of Madness" is a memory. Where is a successor? Where are like fantasies? And out with poor editorials!—Robert Sherwood 208 Pearsall Ave., Jersey City, N. J.

On Artists and Authors.

Dear Editor:

You may remember that I opposed Science Discussions when it was first instituted. Please record my vote for the return of Brass Tacks, though I would prefer a new name—such as "Literary Discussions". Please do not print letters merely rating stories in the current issue; we want letters containing useful advice and helpful criticism. A new "cut" is essential—preferably done by Dold, certainly not by Wesso.

Dold, while not the artist he was when he first appeared, is still one of your best artists. I can't understand why all those fans he had a few years ago do not protest against Wesso's usurpation of his place as chief interior artist. Personally, I can see nothing in Wesso. He uses a type typical of 90% of pulp artists and has a poor artistic sense. Open any detective or western magazine—you will see the same sketchiness in illustrations, the same haziness of background, and the same raggedness of figures. In cover work he is plainly inferior to Brown as is shown by the two covers for "Galactic Patrol". Not one of Wesso's covers has been a quarter as good as Brown's for July. Yes, despite temporary lapses, Brown is the science-fiction cover artist. Jack Binder is a very promising interior artist and I would like to see more of his work. His illustrations for "Forgetfulness", "The Endless Chain" and "Queen of the Skies" were quite up to Dold's best standard. As to the rest of your artists, Thomson and Saaty are average, Schreeman is mediocre, Flatos is rank and Marchioni is just a caricaturist.

Congratulations on "Patrol" which is the best serial you have yet published. Especial praise is due to Dr. Smith for getting away from those pages of boring technicalities. If anyone is still in doubt as to Wesso's worth, let him compare Wesso's illustrations for "Galactic Patrol" with Dold's for "Skylark of Valeron". I would appreciate a serial by Stuart, Taine or Manning to follow this.

After such an outstanding October issue, a slump is practically inevitable, but I didn't expect such a huge drop. Only two complete stories (and both shorts!) are worth reading—"A Surgical Error", which had an interesting plot, and "Marinorro" which had an interesting

style. Schachner's horror is even worse than "Crystallized Thought". Can't you get rid of him, or is he under contract?

The following are the best ten stories you have published this year.

1. "Forgetfulness". Ranks with the superb "Twilight". A grand plot.
2. "Galactic Patrol". Far and away better than "Valeron" or "Triplanetary".
3. "Seeker of Tomorrow". Entertaining, original and exceedingly well-written.
4. "Sands of Time". P. S. Miller at his best.
5. "The Endless Chain". An old plot, but I like the strain of mysticism.
6. "Fires of Genesis". Gallun is now consistently good.
7. "Out of Night". Stuart can do much better, nevertheless, good
8. "Great Radio Peril". Good humorous satire.
9. "Saga of Pelican West". Blood and thunder, but reminiscent of Weinbaum.
10. "Frontier of the Unknown". Rather slow. Boring in places.

Give us more stories by Stuart, Russell (especially in collaboration with Johnson), Ayre, Macfadyen, P. S. Miller, C. L. Moore and Gallun. Is there any hope of our getting Manning, Kelly, Keller, Hilliard, Connell, J. B. Harris, Vaughan or Wede?

Let us have more stories with the accent on style, not plot. Really good authors, such as the late Stanley Weinbaum, can retain plausibility, no matter how fantastic the plot is. If you want a slogan, use this "Back to 1934!" During your first two years you printed really worth while stuff. Stories destined to endure. And now you give us "Air Space!"

If you are retaining Brass Tacks, please publish the following:

I would like to correspond with any fans, preferably in England, who are interested in the literary side of fantasy, poetry or chess. Readers farther afield are also welcome.—S. Youd, Jr., 244 Dearborough Rd., Eastleigh, Hants, England.

Our articles are our Science Department. "Unseen Mass" definitely was NOT hokum.

Dear Mr. Campbell:

Your editorial "The Unseen Mass" in the December issue came as a great surprise to me. I had hitherto presumed that you tossed most of the letters from readers into the wastebasket unread. It appears that I have done you a great injustice, so please accept my humble and profuse apologies in regard to this matter.

It is truly encouraging to think that this letter may be read. I had formerly believed it to be a greater effort to read a letter than to write one (since our chirography is so far from perfect). But it now seems that you can not only decipher our scrawl, but actually do read our letters. This is a step toward the science-fiction fan's idea of the millennium. Allah be praised! Maybe you will even adopt my suggestion (a

little later on) and raise the price of the magazine to a quarter of a dollar, and use the extra nickel toward making an even greater magazine.

I, for one, would greatly like to see a real Science department in our magazine in which late scientific discoveries and news can be published. For instance, what the astronomers are doing with the giant 200 inch reflector (haven't heard a thing about it lately) and discoveries of new stars, novae, and comets; new scientific theories; progress in atom-smashing; use of the cyclotron, etc.; explanations of relativity, and other deep scientific theories in language comprehensible to the average science-fiction fan. Such a Science department as this added to our magazine would be worth not merely a nickel to me—it alone would be worth a quarter.

But maybe I've started crowing too soon, and this letter will follow my previous letters into the wastebasket. If I don't hear any more about this matter (regarding a Science department), I shall consider your editorial "The Unseen Mass" a true example of hokum.

How about it, Old Man?—C. H. Osborne, 5 Hill St., Sheldon Springs, Vt.

Two Science Features? Author Campbell changed status—but the cover was already printed.

Dear Editor:

It has been several months since I wrote you last, and in the intervening time I have been doing a lot of thinking about our magazine and science-fiction in general. As a consequence, this letter will probably be rather long and rambling, so be prepared!

First, a few words about the December issue. It is up to your average, and contains some excellent ideas. "Dark Eternity" I did not like. My reasons are given further on in this letter. "City of the Rocket Horde"—which I just finished—made very interesting reading, and I liked it. I suppose there will be more stories in this series. If so, it's o. k. with me. Schachner is still below his old level, but is improving. Oh, for the days when he turned out stuff like "Ancestral Voices", "He from Procyon", and maybe "Stratosphere Towers"! Another pip by this author is "The Orb of Probability". Nowadays, his stories have a dreary element of sameness—but as I said before, he's improving. "Mana" was good—far superior to that ghastly thing, "The Saga of Pelican West". "The Mind Master" (an old title) was interesting, but the idea was not new. D. D. Sharp recently had a vastly superior story on the same topic. "The Time Contractor" was faintly amusing, and reminiscent of the Van Manderpootz stories by Weinbaum. I have not read the science article, but it looks very good. By the way, it said "Two science features in this issue" on the cover—where's the other? I notice that Campbell's series has been concluded—rather abruptly, too. As for "Galactic Patrol"—more later.

Now for the real purpose of this letter. I will start off my discussion by saying that I think I have found the nature of that "indefinable something" that made the stories of the "Good Old Days" tickle! It is really quite simple—in fact that statement sums up the whole thing! You see, the stories of the old days contained *simple, logical* ideas, *simply* developed, with a dash of human interest and factual science added. The things those stories brought out were not impossible nor improbable; they might come about in the near future! Those stories told of some new invention or discovery, the idea being based on present-day science; then a story was woven around that idea. Compare "The Island of Dr. Moreau", "Armageddon, 2419, A. D.", "Flight to Venus", "Death of the Moon", "Ark of the Covenant", even "The Skylark of Space", to present-day stories. To-day we have gigantic machines altering the cosmos; we have extra-dimensional space-strains induced by sudden liberation of atomic power; we have the cosmos reverting to a primal state; we have science achieving universe-shaking things of such magnitude that *anything* can happen, and where scientific explanations become impossible! Since nothing is impossible to present-day authors, everything they write becomes uninteresting. It strains the credulity far too much! These doings of

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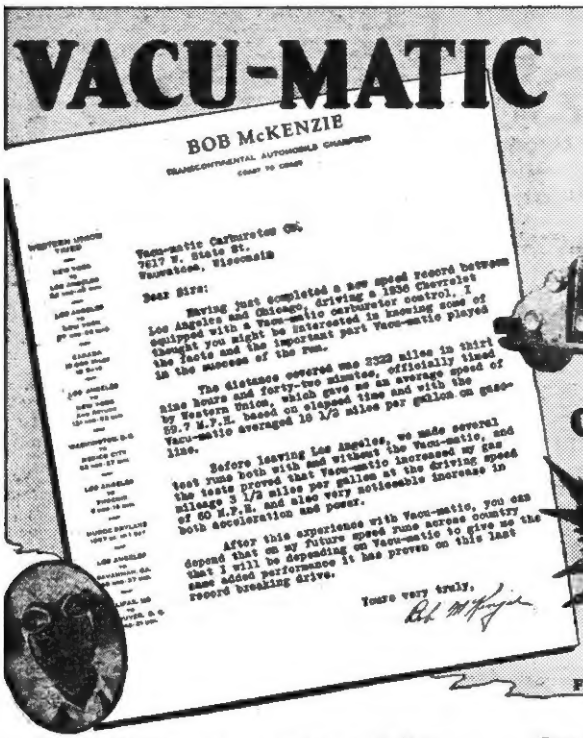

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"ultra-science" becoming boring, often partaking of the fairy-tale! And to make a bad thing worse, many modern authors, realizing their conceptions cannot be explained by present-day science, try to make their yarns appear scientific by doctoring them up with meaningless pseudo-scientific explanations, which I will term "stupor-science". Look at Williamson's "Released Entropy", for instance; Fearn's "Liners of Time", "Mathematica", and the rest of his tripe!

Smith often indulges in "ultra-science", sending his spaceships scooting around the galaxy at trillions of miles per second, propelled by Smith-only-knows-what! Look at "Galactic Patrol!" Ten light-years away—"Right in our laps"! Tch-tch! Does Mr. Smith expect anyone to swallow that? Such things *might* happen ten billion years from now, yes, but Smith's yarns take place only a couple of centuries hence. And if they were laid in their proper time, they would be so distant from the present that they would not concern us! But Smith tackles those conceptions the best of anyone I know. He makes his characters commonplace, works out an entire system of space-navigation, and goes ahead—and, what is more, does not use misleading "stupor-science". Further, his stories are written in a thrilling, fascinating style, so that one cannot help but like them. "Galactic Patrol" is a good example of this.

However, most authors do not have Smith's gift, and it is they that I want squelched. No, let me correct that, I do not want them squelched, but I want them to stick to good, logical, plausible ideas scientifically explained, not the improbable rubbish they now turn out. Now, not all science-fiction stories are of the "ultra" and "stupor" science types; many of them still have that blessed simplicity. But the ultra-type are becoming more prevalent, and one of your rivals indulges in them steadily. I might go so far as to say that one "ultra-science" or even "stupor-science" story is o. k. —"Liners of Time" gave me a big kick—but when two or three appear in every issue of "all three", it's going too far! See what you can do about that, will you? Thanks.

This letter is too long—and probably too poorly written—to be published in Brass Tacks. But what th' heck! It's a dandy department, and keep it going. Enlarge it, too, to about three pages, with Science Discussions taking up another three. Thanks a lot for bringing Brass Tacks back.

A final word: Try to get John Taine to write a new serial novel for you. "Twelve Eighty-seven" was very good, but most of his stories are much better! I don't hope for another "Time Stream", but just get *something* out of him, and I'll be satisfied! I'll be lookin' for it about this time next year!—Paul H. Spencer, 88 Ardmore Road, West Hartford, Conn.

Please stick to brickbats—spiked clubs barred!

Dear Editor:

This will belong, no doubt, in your Brass Tacks division of letters to the editor, but whether it ever appears there is another question.

Unquestionably, we science-fiction fans are among the more gullible and long suffering of any of those who lay it on the line and make possible the continuance of this type of magazine. This is more in sorrow than in anger, and comes after a long experience, dating from Vol. I Number 1 of the old Amazing Stories. I am one of those who have religiously followed this type of fiction, including your own, and I believe I can safely say that over the years, it has been 90% tripe, 8% interesting and 2% outstanding.

All right, Mr. Editor, why do I continue? On account of the occasional jewel that is uncovered. Also, I read science-fiction as some men read detective stories—as a relaxation or "escape mechanism" as our more learned brethren would say.

I would really like to know why for so long 99% of stories are aimed at what would seem to be high school freshmen? Perhaps your clien-

tele among we older men is not so numerous. I realize that strictly first class science-fiction is hard to find, but why, oh why, are we called upon to digest some of the wilder and less logical types of stories, and poorly constructed from a writing point of view? Mr. Editor, your conscience should trouble you, and you must have held your nose while o.k.ing some of them. I am not going to be specific, but the list is long, also, why have "hack" writers who turn out fill-ins for every issue or so? Believe me, they get tiresome.

I am somewhat disappointed with Dr. E. E. Smith's "Galactic Patrol". When he wants to Dr. Smith can turn out a wonderful yarn. "Galactic Patrol" is readable, but that is all. The third issue contains at least one glaring discrepancy, namely, how did Helmuth get the thought screens from Velantia? In fact I don't it represents Helmuth as saying Velantia can wait and be reduced later, there is nothing to show that the pirates and Helmuth in particular had ever been there. But lo and behold, Helmuth blossoms out in a complete thought screen outfit. Some one dropped a stitch badly there.

It was my very great pleasure to read "The Skylark of Space", "Skylark III", and "Spacehounds of IPC". Dr. Smith is slipping. It seems to me he is trying to coast on his laurels and has not performed the necessary revision that he would require from one of his students, assuming that he is a professor. Dr. Smith's reasoning is logical and, as I said before, his tale is readable. But I fear he will soon be a "hack" writer, writing pot boilers such as Nat Schachner turns out on order for you.

As for your illustrations, save the money to put into stories.

As an editor you have a tough job to satisfy a person with a mature mind. I am bound to admit the vast improvement in your magazine in the past few months. John Campbell's articles alone are worth the price of your magazine. Your science articles are most of them good. "Talking Hill" was terrible and the article on positions just too technical.

In looking this over, I find I am tough on the editor? Well it is your baby and you asked for it. Your Science Discussions sound like high school physics students trying to sound grown-up. If the majority of them would read through an elementary physics, there would be nothing to discuss. The exchange on the subject of Atlantis, etc., is by far the best that has appeared, because it was conducted by men who had something to say and *knew how to say it.*

I believe I have said enough. In closing let me repeat my appreciation of the improvement you have wrought, but you will be the first to admit that there is room for more. Please deliver us from the "one man whips the universe at the last minute" stuff. Williamson take notice for one. Get your authors to take a good course in English composition somewhere, and we will all be happier.—Arthur B. Dawson, Box 274, Plano, Ill.